

The Effectiveness of Mathematics Learning Through the Application of Approaches *Realistic Mathematics Education* (RME) in Increasing the Ability of *Pedagogical Content Knowledge* (PCK) Mathematics Teachers

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ABSTRACT

Type of research is pre-experimental research that aims to determine the effectiveness of mathematics learning through applying the approach *Realistic Mathematics Education* (RME) in increasing the ability of *Pedagogical Content Knowledge* (PCK) mathematics teachers. This study refers to three indicators of learning effectiveness: completeness of the student learning outcomes, the student activities, and the positive student responses to the implementation of learning through the RME approach. The research design used is *the one-shot case study*, namely pre-experimental research carried out with one group to be given treatment and post-test (final test). The experimental unit was class VIII.B of SMP Guppi Samata Gowa with 18 students. The results showed that: (1) the students' average score in mathematics learning outcomes after the RME approach was applied was 81.29 with a standard deviation of 10.17. These results showed that 16 the students (88.89%) reached KKM and 2 the students (11.11%) did not reach KKM, which means that in the classical learning completeness has been reached, the result of inferential analysis test *one sample test* obtained *P-value* <, i.e., $0.000 < 0.05$ then H_0 is rejected, (2) The average percentage of the frequency of student activities actively involved in learning is 78% has reached good criteria, (3) The average percentage of the students' positive responses to learning mathematics is 89.68% and only 10.32% of negative responses. From the research results above, it can be concluded that learning mathematics is effective through applying the RME approach to class VIII students of Guppi Samata Islamic boarding school Gowa. The effectiveness of learning with the RME approach can improve teachers' pedagogical abilities and content knowledge (PCK) with the experiments that have been carried out.

Keywords: *Effectiveness, Approach Realistic Mathematics Education, PCK.*

1. INTRODUCTION

Learning is an important thing that cannot be separated from education. Learning is a process to change individuals' behavior because individuals' experiences are a learning process that will change individuals' behavior, from not understanding to understanding, from not being able to be able, and from doubting to being sure. Students can show success in learning through attitudes and behavior on what is taught in school.

The important thing that cannot be separated from education is the learning process. Learning itself

comes from the word learning. Learning is behavior. Someone who experiences the learning process will experience changes in behavior, namely from not understanding to understanding, from not being able to be able, and from doubting to being sure. Students can show success in learning through attitudes and behavior on what is taught in school.

Mathematics is one of the important subjects in the development of science. Most students think of mathematics as an abstract, theoretical science full of confusing symbols and formulas. Abstract mathematical objects become one of the factors

causing learning difficulties for students. They assume that learning mathematics is useless in their life so that the students do not seem interested to learn mathematics.

RME (*Realistic Mathematical Education*) or Realistic Mathematics Education is one learning approach that uses a "real world" context. It meant showing students the relationship between mathematics and life by applying *Realistic Mathematics Education* (RME) to mathematics learning. Mathematics learning is designed to start from problem-solving students can imagine that. The researcher expected that the learning approach makes the students more interested and motivated in the learning process because they know the usefulness of learning mathematics in their life [6].

RME incorporates views on mathematics, *how students learn* mathematics, and *how mathematics should be taught*. He suggests Realistic Mathematics Education (PMR) is a promising approach in learning mathematics. Various literature states that PMR has the potential to improve students' mathematical understanding [8].

There are four indicators of effective learning, namely: (1) cognitive learning outcomes, (2) affective learning outcomes, (3) complete learning, (4) student responses [9]. Therefore, referring to this opinion, it can be concluded that the indicators of learning effectiveness in this study are: (1) student learning outcomes, (2) student activities ineffective learning, (3) positive response to ongoing learning.

As for the indicators of the effectiveness of learning in this study, namely:

1.1. *Student Learning Outcomes*

Learning outcomes are abilities (*performance*) that can be observed in a person and are called capabilities [1]. Learning outcomes are students' abilities after they receive their learning experiences [7].

From the explanation above, it can be concluded that learning outcomes are changes that occur after carrying out a series of teaching and learning activities. These changes are not only in behavior but also in the form of understanding and abilities.

The student's learning outcomes in this study are the final grades obtained after passing the tests after receiving material teaching through *Realistic Mathematics Education* (RME). The student learning outcomes are directed at achieving this level of student mastery measured from the scores obtained by students based on the learning outcomes test given. Based on the KKM set at the Guppi Samata Gowa Islamic Junior High School, the student is said to have completed learning if the student's learning outcomes reach a score ≥ 70 and complete classically if there are $\geq 85\%$ of the number of students in the class who have achieved a score ≥ 70 .

1.2. *Student Learning Activities*

Sardiman suggests that learning activities can be physical or mental. In the learning process, the two activities must be interrelated [3]. The learning activities must involve all psychophysical aspects of students, both physically and spiritually, so that accelerated changes in behavior can occur quickly, precisely, easily, and correctly, both related to cognitive, affective, and psychomotor aspects [5].

Based on the definition above, learning activities are student involvement in attitudes, thoughts, and attention in learning activities. The acceleration of behavior change can occur quickly, precisely, easily, and correctly, related to cognitive, affective, psychomotor aspects.

Student learning activities referred to in this study are activities or behaviors displayed by students during the activity.

1.3. *Student Response*

According to Ahmadi, a response is a picture of memories and observations. The object that has been observed is no longer in the space and time of observation. In line with Kartono, a response can be identified as a memory image from the observation [4].

One of the teacher competencies that can support the learning process is pedagogic competence. Another term for pedagogic competence is *Pedagogical Content Knowledge* (PCK). PCK was first introduced by Shulman [10]. He stated that professional teacher competencies are described as three pillars of knowledge such as material knowledge (*Content Knowledge*), pedagogical knowledge (*Content Knowledge*), and specific fields, namely a combination of *Content Knowledge* and *Content Knowledge* so that it is called *Pedagogical Content Knowledge* (PCK). [2] Content knowledge is a key component in learning, especially in mathematics. It has a crucial role in facilitating students to think that a teacher must master the mathematics content and know-how to transfer lessons to understand them easily.

2. RESEARCH METHODS

The type of research is experimental research involving one class known as pre-experiment design because it only affects one class as the experimental class. This study aims to determine the effectiveness of learning mathematics by applying the realistic mathematics education (RME) approach in class VIII of Guppi Samata Islamic Boarding School Gowa.

The design of this research is a *one-shot case study*. This form of design begins with the determination of the subject as an experimental sample.

Table 1. *The One-Shot Case Study Design*

Treatment	Post-test
<i>X</i>	<i>T</i>

Description:

X = Treatment, namely learning mathematics by applying the Realistic Mathematics Education (RME) approach

T = Final test or evaluation [11].

The research instruments used to collect data were 1) learning outcomes tests, 2) observation sheets, and 3) student response questionnaires. The data analysis technique used is descriptive statistical analysis and inferential statistical analysis.

3. RESULT AND DISCUSSION

3.1. RESULT

3.1.1. Descriptive Statistical Analysis

3.1.1.1. Description of Student Learning Outcomes by Applying Approach The *Realistic Mathematics Education (RME)*

After being given treatment, the following is a description and percentage of students' mathematics learning outcomes in class VIII.B SMP Guppi Samata Gowa Islamic Boarding School.

Table 2. Statistics of Mathematics Learning Outcomes Scores for Class VIII.B Middle School Students at Guppi Samata Gowa Islamic Boarding School after being given treatment

Statistics	Value Statistics
Sample Size	18
Highest Score	96,67
Lowest Score	60
Ideal Score	100
Score Range	36,67
Average Score	81,29
Median	83,33
Mode	73,33
Standard Deviation	10,17
Variance	103,46

In table 2, it can be seen that the average score of student learning outcomes in class VIII.B SMP Pesantren Guppi Samata Gowa after the learning process through the application of the approach *Realistic Mathematics Education (RME)* is 81.29 from the ideal score of 100 that students may achieve with a standard deviation 10,17. The scores achieved by these students ranged from the lowest score of 60 to the highest score of 96.67, with a score range of 36.67. The median is the middle value (50%) after the data is sorted. So the median value of 83.33 means that 50% of the sample has mathematics learning outcomes of 83.33 and above, and 50% has 83.33 mathematics learning outcomes and below. The mode is the data with the most frequency, so the

information on mathematics learning outcomes that appear most often is 73.33. The frequency and percentage distributions are obtained if the students' mathematics learning outcomes are grouped into 5 categories.

Table 3. Distribution of Frequency and Percentage of Scores in Mathematics Learning Outcomes of Class VIII.B the Students of Guppi Samata Gowa Islamic Boarding School after being given treatment

Value of Learning Outcomes	Category	Frequency	Percentage (%)
$0 \leq x < 55$	Very Low	0	0
$55 \leq x < 70$	Low	2	11,11
$70 \leq x < 80$	Medium	6	33,33
$80 \leq x < 90$	High	5	27,78
$90 \leq x \leq 100$	Very High	5	27,78
Total		18	100

Table 3 shows that there were 18 students in class VIII.B of SMP Pesantren Guppi Samata Gowa. Students who scored in the very low category were 0 students (0%), the students who scored in the low category were 2 students (11.11%). The students who scored in the medium category were 6 students (33.33%), the students who scored in the high category were 5 the students (27.78%) and students who scored in the very high category were 5 students (27.78 %). After the average score of the student learning outcomes of 80.92 was converted into the 5 categories above, the average score of grade VIII.B students' mathematics learning outcomes after being taught through the application of the approach *Realistic Mathematics Education (RME)* was in the high category.

Furthermore, the learning outcomes data after learning through the application of the approach *Realistic Mathematics Education (RME)*(*post-test*) are categorized based on the criteria for completeness which can be seen in Table 4.3 as follows:

Table 4. Description of the Students' Achievement of Complete Mathematics Learning Outcomes in Grade VIII.B at SMP Guppi Samata Gowa Islamic Boarding School

Value	Criteria	Frequency	Percentage (%)
$0 \leq x < 70$	Uncompleted	2	11,11
$70 \leq x \leq 100$	Completed	16	88,89
Total		18	100

2 students did not complete the test (11.11%), while the students who met the individual

completeness criteria were 16 students (88.89%). If table 4 is related to the indicators of the student learning outcomes, it can be concluded that the mathematics learning outcomes for class VIII.B after applying the approach *Realistic Mathematics Education* (RME), have met the classical learning outcomes mastery indicators.

3.1.1.2. Description of the Student Activities during Mathematics Learning by Applying Approach *Realistic Mathematics Education* (RME)

This observation sheet was made to obtain one type of data to support learning effectiveness criteria. This instrument contains instructions and 7 indicators of observed student activity. Observations were carried out through an *observer* observing the student activities conducted during the four meetings. The data obtained from the instrument are summarized at the end of each meeting. The results of the summary of each observation are presented in table 5 below.

Table 5. Description of the Student Activities during Mathematics Learning by Applying Approach *Realistic Mathematics Education* (RME)

No.	Observed activity	Percentage (%)
Positive Activity		
1.	The students understand the contextual problems presented by the educator.	88,89
2.	The students ask questions to educators/friends if there are things that have not been understood	50
3.	The students join their groups and observe and solve questions on the LKPD distributed by educators	88,89
4.	The students actively compare and discuss answers in groups.	84,72
5.	The students present answers from their groups or respond to answers from other groups	65,28
6.	The students write conclusions from the material they just learned	90,27
Average percentage		78
Negative Activities		
7.	Students carry out activities not relevant to KBM (not paying attention, disturbing friends, going in and out	12,5

No.	Observed activity	Percentage (%)
of the room without permission).		
Average percentage		12,5

The criteria for the success of the student activities in this study are good if more than 75% of the students are actively involved in positive activities during learning. Based on table 5, the student activities in this study are said to be good. This can be seen from the average percentage of positive student activity, which is 78% active in learning mathematics. However, 12.5% of the students carried out other activities during the learning process because they sometimes tell stories with their group friends, disturb other groups, and ignore learning.

3.1.1.3. Description of the Student Response to Mathematics Learning by Applying Approach *Realistic Mathematics Education* (RME)

The results of data analysis on the student responses to the implementation of mathematics learning by applying the approach *Realistic Mathematics Education* (RME) filled by 18 the students are briefly shown as follows.

Table 6. Description of the Student Responses to Mathematics Learning by Applying Approach *Realistic Mathematics Education* (RME)

No.	Questions (Responded Aspects)	Percentage	
		Yes/Positive	No/Negative
1.	Are you happy with the process of learning mathematics through the approach of <i>Realistic Mathematics Education</i> (RME)?	100%	0%
2.	Do you like the learning atmosphere in the classroom by applying the approach <i>Realistic Mathematics Education</i> (RME)?	100%	0%
3.	Do you understand the material taught by the educator through the application of the approach <i>Realistic Mathematics Education</i> (RME)?	88,89%	11,11%
4.	Can the approach <i>Realistic</i>	100%	0%

No.	Questions (Responded Aspects)	Percentage	
		Yes/ Positive	No/ Negative
	<i>Mathematics Education (RME)</i> in learning help make it easier for you to understand the subject matter?		
5.	Do you like the LKPD used when learning mathematics with the approach <i>Realistic Mathematics Education (RME)</i> ?	77,78%	22,22%
6.	Are you more skilled in solving problems related to everyday life after applying the approach <i>Realistic Mathematics Education (RME)</i> ?	100%	0%
7.	Are you interested in teaching applied by educators with the approach <i>Realistic Mathematics Education (RME)</i> ?	100%	0%
8.	Do you have more opportunities to ask questions and express opinions during the learning process?	66,67%	33,33%
9.	Do you feel that you have progressed after taking mathematics lessons by applying <i>Realistic Mathematics Education (RME)</i> ?	88,89%	11,11%
10.	Are you interested in participating in the next mathematics lesson by applying <i>Realistic Mathematics Education (RME)</i> ?	100%	0%
11.	Are you more motivated to learn mathematics by applying the approach <i>Realistic Mathematics Education (RME)</i> ?	94,44%	5,56%
12.	Do you enjoy discussing answers from other groups with your group	66,67%	33,33%

No.	Questions (Responded Aspects)	Percentage	
		Yes/ Positive	No/ Negative
	mates after applying <i>Realistic Mathematics Education (RME)</i> ?		
13.	Have you become an active learner in class after applying the approach of <i>Realistic Mathematics Education (RME)</i> ?	94,44%	5,56%
14.	Do you agree that in the next lesson (specific topics), educators apply the approach of <i>Realistic Mathematics Education (RME)</i> ?	77,78%	22,22%
Average Percentage		89,68%	10,32%

Based on table 6, the average student of class VIII.B SMP Guppi Samata Gowa responded positively to learning through the Application of *Realistic Mathematics Education (RME)*. The average percentage of student responses in the positive category was 89.68%. Therefore, the student response can be effective because it has met the students' responses criteria, namely more than 75% positive responses.

3.1.2. Inferential Statistical Analysis

3.1.2.1. Normality Test

The test aims to determine whether the average score of the student learning outcomes is normally distributed. The test criteria are:

If $P_{-value} \geq \alpha = 0,05$ then the distribution is normal.

If $P_{-value} < \alpha = 0,05$ then the distribution is not normal

Using the help of a computer program with the *Statistical Product and Service Solutions (SPSS)* version 20 program with the Test *Kolmogorov-Smirnov*. The results of the analysis of the average score for the *Posttest* show the $P_{-value} > \alpha$, which is $0,200 > 0,05$. It meant that H_0 was received, which means scores *post-test* categorized as normal.

3.1.2.2. Hypothesis Testing

The average student learning outcomes after being taught by applying the *Realistic Mathematics Education (RME)* approach is calculated using a one-sample t-test which is formulated with the following hypothesis:

$$H_0: \mu \leq 70 \text{ against } H_1: \mu > 70$$

Description: μ = Parameter score of the average student learning outcomes

Based on the results of the SPSS analysis using a significant level of 5%, it appears that the p-value (*sig. (2-tailed)*) is $0,000 < 0,05$ indicating that the average learning outcome students after being taught through the application of the *Realistic Mathematics Education* (RME) Approach are more than 70. This means that H_0 is rejected and H_1 is accepted, namely the average post-test learning outcome of class VIII.B students at Guppi Samata Gowa Islamic Boarding School more than the KKM score.

The students' learning mastery after being taught by applying the *Realistic Mathematics Education* classical (RME) approach is calculated using the proportion test, which is formulated with the following hypothesis:

$$H_0: \pi \leq 80\% \text{ against } H_1: \pi > 80\%$$

Description : π = classical mastery learning parameters

Mastery testing of students is done by using the proportion test. For the proportion test using a significant level of 5%, it is obtained that the value $Z_{count} = 0,481 > Z_{table} = 0,1843$ then H_0 rejected, meaning that the proportion of students who achieve in classical completeness criteria (KKM=70) $> 80\%$.

Based on the description above, it can be seen that the proportion of students who reach the 70 completeness criteria (KKM) is more than 80%.

From the analysis above, it can be concluded that the average score of the student learning outcomes after learning through the application of the approach *Realistic Mathematics Education* (RME) has met the effectiveness criteria.

3.2. DISCUSSION

Table 7. Achieving the Effectiveness of the Application of Approach *Realistic Mathematics Education* (RME)

No.	Effectiveness Indicator	Description	Conclusion
1.	The Student Learning Outcomes	Completely	Effective
2.	The student Activities	Good	
3.	The student Response	Positive	

3.2.1. Result of Descriptive Analysis

3.2.1.1. The Student Mathematics Learning Outcomes After Learning by Applying the approach *Realistic Mathematics Education* (RME)

The results of the data analysis of the students' mathematics learning outcomes after applying the approach *Realistic Mathematics Education* (RME) were in the high category with an average score of 81.29 out of 18 students, 2 students did not achieve individual mastery or 11.11%, and there were 16 the students who have completed individual

mastery or 88.89%. This means that the students in class VIII.B of Guppi Samata Gowa Islamic Junior High School achieve classical mastery because classical mastery is achieved when more than 80% of the students in that class have reached the minimum completeness score set by the school.

3.2.1.2. The Student Activities during mathematics learning by applying the approach *Realistic Mathematics Education* (RME)

The results of observing the student activities during mathematics learning by applying the *Realistic Mathematics Education* (RME) approach to Class VIII.B students of Guppi Samata Gowa Islamic Boarding School show that the students are active in learning and have met the active criteria because according to the student activity indicators that student activities are said to be successful. Effective if more than 75% of the students are actively involved in the learning process. While the results of the data analysis of student activity observations showed the average percentage of student activity frequency by applying the approach, *Realistic Mathematics Education* (RME) was 78% of the student activity, which increased every meeting. It can be concluded that the students have actively participated in the mathematics learning process by applying the approach of *Realistic Mathematics Education* (RME).

3.2.1.3. Student responses to mathematics learning by applying the approach *Realistic Mathematics Education* (RME).

From the students' response analysis, it was found that 89.68% of the students gave a positive response to the implementation of mathematics learning through the application of the approach *Realistic Mathematics Education* (RME). This means that applying the *Realistic Mathematics Education* (RME) approach can change the students' views of tedious and challenging mathematics towards fun mathematics. The desire to learn mathematics is greater. The analysis results showed that learning through the approach *Realistic Mathematics Education* (RME) has reached the indicators of effectiveness that are used as benchmarks, where positive responses are more than 75% of all respondents.

3.2.2. Results of Inferential Analysis

The results of the inferential analysis show that the post-test data has met the normality test, which is a prerequisite test before testing the hypothesis. Posttest data were normally distributed because the p . value $> \alpha = 0,05$.

The results of the inferential analysis show that the average score of the student learning outcomes after learning through the application of the approach *Realistic Mathematics Education* (RME) appears that the p-value (*Sig. (2-tailed)*) is $0,000 < 0,05$, meaning

that the students' mathematics learning outcomes can reach KKM 70. The mastery of the student learning after being taught by applying the *Realistic Mathematics Education* classical (RME) approach is more than 80%. So, it can be concluded that the classical mastery of the students after being taught by applying the approach is *Realistic Mathematics Education* (RME) more than 80%.

Based on data analysis, it is quite supportive of the theory that has been put forward in the introduction. Thus, it can be concluded that "Mathematics learning is effective by applying the *Realistic Mathematics Education* (RME) approach in the students of SMP Guppi Samata Gowa Islamic Boarding School." The effectiveness of the RME approach can provide an increase in the PCK of mathematics teachers, such as knowledge of how to teach with content knowledge (knowledge of teaching materials) by paying attention to the three indicators of learning effectiveness.

4. CONCLUSION

The results of the descriptive analysis show that the students' mathematics learning outcomes after learning through the application of the approach is *Realistic Mathematics Education* (RME) included in the high category with an average value of 81.29 and a standard deviation 10.17. The results show that there are 16 students or 88.89% who reach the KKM and 2 students or 11.11% who do not reach the KKM (scores below 70), so it can be said that the student learning outcomes have reached the classical completeness criteria.

Learning through applying the *Realistic Mathematics Education* (RME) approach to class VIII.B students of SMP Guppi Samata Gowa received a positive response with an average percentage of students who gave a positive response of 89.68% of the total number of students.

The Student activities related to learning activities from the observed aspects as a whole are categorized as active. This is indicated by acquiring the average percentage of the student activity, which is 78% active in learning mathematics.

The results of inferential analysis using the proportion test with a significant level of 5% obtained the value of $Z_{count} = 0,481 > Z_{table} = 0,1843$ then H_0 rejected. $(KKM = 70) > 80\%$, which means the proportion of students who achieve classical completeness criteria ($KKM = 70$). So, it can be concluded that the students' mathematics learning outcomes after being taught by applying the Approach *Realistic Mathematics Education* (RME) meet the criteria for effectiveness.

Based on the learning effectiveness criteria stated previously, effective mathematics learning applies the *Realistic Mathematics Education* (RME) approach in class VIII.B of Guppi Samata Islamic Boarding School Gowa.

The effectiveness of the RME learning approach can increase the teacher PCK, in this case, knowledge of how to teach with teacher content knowledge (knowledge of teaching materials)

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