

## The Effect of Realistic Mathematics Education Approach on Students' Achievement And Attitudes Towards Mathematics

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### Abstract

This study was conducted to determine the effect of Realistic Mathematics Education Approach on mathematics achievement and student attitudes towards mathematics. This study also sought determine the relationship between student achievement and attitudes towards mathematics. This study used a quasi-experimental design conducted on 61 high school students at SMA Unggul Sigli. Students were divided into two groups, the treatment group (n = 30) namely, the Realistic Mathematics Approach group (PMR) and the control group (n = 31) namely, the traditional group. This study was conducted for six weeks. The instruments used in this study were the achievement test and the attitudes towards mathematics questionnaires. Data were analyzed using SPSS. To determine the difference in mean achievement and attitudes between the two groups, data were analyzed using one-way ANOVA test. The result showed significant differences between the Realistic Mathematics Approach and the traditional approach in terms of achievement. The study showed no significant difference between the Realistic Mathematics Approach and the traditional approach in term of attitudes towards mathematics. It can be concluded that the use of realistic mathematics education approach enhanced students' mathematics achievement, but not attitudes towards mathematics. The Realistic Mathematics Education Approach encourage students to participate actively in the teaching and learning of mathematics. Thus, Realistic Mathematics Education Approach is an appropriate methods to improve the quality of teaching and learning process.

**Keywords:** Realistic Mathematics Education, Attitudes Toward Mathematics, Achievement.

### 1 Introduction

The teaching of mathematics in Indonesian schools was started since 1973, where the government changed the system of teaching arithmetic in elementary school (primary school) to the teaching of Mathematics. Since then the teaching of mathematics in schools became a compulsory subject from primary, lower secondary and upper secondary school. However, the lower grade achievement in examination among students is still an issue faced by teachers in the teaching of mathematics in schools, as well as the

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standardized examination conducted by the government [1]. Results of a study conducted by the Trends in International Mathematics and Science Study (TIMSS), which was issued at the end of 2011 [2] found that student mathematics achievement in Indonesia is the 38th out of 42 countries with an average score of students in Indonesia is 386 where the overall average score was 500. Scores of Indonesian students is down by 11 points from 2007. The position of Indonesia is much lower than Korea (613) in the first position. The low quality of students in mathematics as reported by TIMSS, can not be separated from teaching and learning process conducted by all teachers of Mathematics. As stated by [3] the process and results of teaching and learning are two things that do not stand alone but are intertwined with each other. Student achievement is the results obtained from the learning process carried out by teachers and students. The quality of a lesson is also depends on what teachers do in the classroom to produce excellent human capital in the future [4]. [5] also noted that the success of the educational process in schools, more specifically in the classroom, are determined by the teaching and learning process implemented directly by the teacher.

Mathematics education in Indonesia is undergoing a paradigm shift, whereby a positive transformation occur in Mathematics education curriculum at the primary and secondary schools. In addition to curriculum development, various attempts have been made by the government to improve the quality of learning in schools. The government also assisted by various parties concerned with mathematics education. Among these efforts are: (1) teacher training, (2) the educational qualifications of teachers, (3) inculcation of new model or methods of teaching and learning, (4) the study of the difficulties and mistakes of students in learning mathematics. However, these efforts have not yielded optimal results.

In reality, many of the teachers are still teaching using the traditional approach, in which the teaching of mathematics in schools was introduced in a symbolic or abstract way, and forcing students to memorize. All of these approach are contrary to the cognitive development of students and less benefits for students. According to [5], mathematics teacher should be able to simplify abstract mathematical objects to concrete things and easily understood by students, so that students feel that the lesson learned is meaningful to their daily life.

Most of today's teachers are more focused on learning outcomes as required by the school administration rather than attention given to the learning process. This was done solely for teachers to meet curriculum goals. Teachers do not provide sufficient time for students to be actively involved in learning. As a result, teachers become active and students are passive during the teaching and learning process. This was clearly contrary to the theory in cognitive psychology. According to the developmental theory, knowledge can not be transferred from a teacher to a student, but rather constructed by the students through active participation in the teaching and learning process [6].

[7] stated that teaching that use student experience and environment really helps teachers to improve students' interest and attention to the teaching of mathematics. An approach to learning that has a better profile in understanding students' mathematical concepts and heuristics that is appropriate to the purpose of the curriculum is learning in a realistic or contextual-oriented approach to problem-solving.

Realistic Mathematics Education (RME) approach is a new approach in the field of mathematics education and introduced and developed in the Netherlands about 40 years ago. Realistic approach is based on the idea of Freudenthal which says that mathematics is a human activity [8]. Learning mathematics is seen as a process. Several research has been done about RME. The study by [9] on 20 mathematics teachers in Junior High School (SMP) in Bantul, Sleman and Yogyakarta found that students like the Realistic Mathematics Education approach. The results of [10] also showed that junior high school students are able to solve mathematics problems horizontally (solving math questions with the students' everyday experience), while secondary school students (high school) generally can not do.

The few RME studies done such as [11]; [12] and [13] all focus on elementary school students as a research sample. All these studies looked at the impact of RME on students achievement. [14] conducted a study of elementary school students, but this study differs from other studies, where this study gives special attention to the elementary school students with low achievement.

However now RME began to be used for secondary school students. Studies by [15], [16] and [17], look at the effect of RME on the achievement of students. Meanwhile, a study conducted by [18] determine the effect of RME on the attitudes change of students. The study of RME was also conducted on university students such as [19]; [20] and Zulkardi [21]. The study by Zulkardi looked at the effect of RME on student achievement, as well as the effect of RME on the confidence of the trainees. In all the studies that have been carried most research on RME focus on student achievement, There are also researchers who look at the effects of RME on the attitudes of students. In the teaching of mathematics, other than low student achievement, negative attitudes towards mathematics is also a concerned. As described by [22], there are six beliefs embedded in students that makes them difficult to accept mathematics as an interesting and useful subject : (1) mathematics is a boring subject, (2) mathematics is difficult, (3) mathematics is a subjects that require precision, (4) there are people who think I can not do mathematics because I am a women, and (6) mathematics has no relation with my daily life. These are the things that must be changed by all teachers of mathematics so that students' interest in mathematics can be enhanced. The decline in mathematics achievement is often associated with such attitude as not interested, math was difficult and felt scared while learning math and other negative perception [6]. From previous research, it was found that there was a lack of studies conducted that focuses on both achievement and attitude in using RME. This motivate the researcher to examine how realistic mathematics education (RME) approach can help students to improve their achievement in mathematics, and researchers wanted to see how far the RME can influence students' attitudes toward mathematics.

### **Objectives of the study**

The specific objectives of this study were as follows:

1. To determine whether there is a statistically significant difference in students achievement using the RME approach compared to traditional method.
2. To determine whether there is a statistically significant difference in students' attitudes towards mathematics using the RME approach compared to traditional method.

### **Hypotheses of the study**

The following null hypotheses were tested.

- $H_{01}$ : There is no statistically significant difference in students achievement using the RME approach compared to traditional method.
- $H_{02}$ : There is no statistically significant difference in students' attitudes towards mathematics using the RME approach compared to traditional method.

## **2 Methodology**

### **Research Design**

Since the classes existed as intact group, quasi-experimental non-equivalent control group design study was used in this study. Pre-test was used to determine whether the two groups were similar (homogeneous) and are intended to be used as a statistical control. In the initial stage of the study each group took a pre-test, then both classes were divided into group (the control group and the treatment group) which differ in their teaching methods. After the learning process is carried out both focus took a post-test. The data obtained from the post-test will be used as data in the study which will be analyzed. The following table shows the study design used in this study.

Table 1: Design of the study

	Pre-test	Treatment	Post-test
Experimental group	$O_1$	$X_1$	$O_2$
Control group	$O_3$	$X_2$	$O_4$

In Table 1,  $O_1$  and  $O_3$  is a pre-test for both groups where  $O_1$  pre-test for treatment group and  $O_3$  pre-test for the control group, while  $O_2$  and  $O_4$  represents the post-test for both groups in which  $O_2$  post-test for the treatment group and the  $O_4$  post-test for the control group.  $X_1$  represents the Realistic Mathematics Education (RME) approach implemented in the treatment group while  $X_2$  represents the traditional approach represent the control group. The results obtained from pre and post tests will be analyzed to see the difference between the two groups. Both group were given an attitude questionnaire at the end of the study.

### Participants

The sample in this study were all high school students of Unggul Sigli in class Xa and Xb ( $n = 62$ ). The selection of respondents is based on purposive sampling method. According to [23], purposive sampling method was used when the purpose of the study is to focus on a particular group.

### Research Instrument

The instrument used in this study consisted of mathematics achievement test (pre-test and post-test) for each group and a questionnaire about students' attitudes toward mathematics.

### Mathematics Achievement Test

The mathematics achievement test was consist of 15 multiple-choice questions and 5 open-ended type of questions. Test questions were modified questions from the textbooks and the national final exam question bank. Questions are selected according to the topics of logic that have been set in the mathematics curriculum by the Ministry of Education of Indonesia. Renovation of the needs and requirements that exist in the context of the student environment. The validity of the test questions were validated by an expert from the university i.e the lecturer of Mathematics Education and a number of experienced teachers specializing in the teaching of mathematics at the high school level. Furthermore, the questions were revised by the lecturers, and supervisors to provide additional input for improvement of this instrument. A pilot study was performed and indicated Cronbach alpha coefficient was 0.93.

### Attitude Questionnaire

Attitude questionnaire in this study was taken from the Fennema-Sherman Mathematics Attitude Scale (FSMAS) which was translated into the National Language by [24], this instrument is used to measure the attitude towards mathematics. He further stated that although FSMAS originally was build for the purpose of studying mathematics achievement differences by gender, but now FSMAS began to be used in all types of studies attitudes toward mathematics. This questionnaire consists of 48 items in the form of Likert 5 points scale. The questionnaire consists of four subscales, namely sub-scale of confidence, anxiety, motivation and the use of mathematics. Furthermore, this questionnaire is divided into two categories of item, positive and negative item categories, where the questionnaire consists of 24 positive items and 24 items of negative statement. (See Table 2)

Table 2: Construct and item of the instrument

No	Attitude Scale	Item	
		Positive statement	Negative statement
1	Motivation	1, 9, 12, 24, 40, 47	11, 15, 22, 30, 36, 38
2	Anxiety	5, 18, 32, 33, 37, 42	2, 7, 17, 21, 26, 46
3	Confidence	10, 16, 20, 29, 34, 45	4,14, 28, 39, 41, 43
4	Use of mathematics	3, 6, 19, 25, 27, 35	8, 13, 23, 31, 44, 48
	Total	24	24

The attitude questionnaire was scored by using 5 points Likert scale ranging from 5 (strongly agree), 4 (agree), 3 (less agree), 2 (disagree) and 1 (strongly disagree). The score was reversed for negative items. To ensure that these instruments can be used in the actual study a pilot study was conducted and the Cronbach alpha reliability coefficient was .93. This indicates that the instrument has a strong internal consistency.

### Data Collection

For this study, mathematics achievement test and attitude questionnaire were used to collect data. The researchers administered the instrument with assistance from mathematics teachers in the respective school. The researchers then scored the achievement test and the questionnaire and generated quantitative data which were analyzed.

### Data Analysis

For normality, Kolmogorov-Smirnov test was conducted to determine if two datasets differ significantly. In order to determine differences between group, one way ANOVA was used.

## 3 Findings

### Profile of Respondents

This study involved 61 students from one high school SMA Unggul Sigli. Students were divided into two groups, the treatment group consisted of 30 students, 12 male and 18 female students. For the control group, the number of students involved were 31, 12 male and 19 female students, as shown in Table 3.

Table 3: Profile of respondents

Gender	Group	
	Male	Female
Experimental	12 (40%)	18 (60%)
Control	12 (39%)	19 (61%)
Overall	24 (39%)	37 (61%)

### Mathematics Achievement

Data obtained from the pre-test and post-test for both group is shown in Table 4

Table 4: Mean and standard deviation of the achievement test

	Experimental		Control	
	Pre-Test	Post-test	Pre-Test	Post-test
N	30	30	31	31
M	48.33	76.16	47.74	67.09
SD	7.35	1.031	8.15	1.41

The mean pre-test score for the experimental and control group were at the same level at the start of treatment. The post-test mean for each experimental group and the control group was 76.16 and 67.09 respectively. Descriptive statistics show that the mean score of the experimental group was higher than the control group.

**Pre-test Analysis**

Kolmogorov-Smirnov normality test was conducted to determine if two datasets differ significantly. The significance value of the pre-test scores for the control group is .68 (not significant) and significance value of the pre-test scores for the treatment group is .129 (not significant). This means that both groups are normally distributed (as can be seen from Table 5).

Table 5 Test for normality

Group	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistics	Df	Sig	Statistics	Df	Sig
Control	.15	31	.68	.94	31	.119
Experimental	.14	30	.129	.94	30	.116

**Post-test Analysis**

To determine the effects of RME approach on students achievement, an analysis of students post-test mean scores of achievement was carried out. This was to test hypothesis H<sub>01</sub>.

One-way ANOVA test was carried out to show there is a difference in mean score between the two groups. Significant value F = 8156 and p = .006 < .05, this means that there is a difference in the mean score of the control group compared to the experimental group. The difference in post-test mean achievement is shown in Table 6

Table 6: Differences in post-test achievement

	SS	Df	MS	F	Sig
Between group	1254.173	1	1254.173	8.156	.006
Within group	9072.876	59	153.778		
Total	10327.049	60			

From the findings, it was concluded that the hypothesis H<sub>01</sub> is rejected. This means that there is a significant difference between mathematics achievement of students taught with Realistic Approach to Mathematics approach and students taught with a traditional approach, where students who are taught to by Realistic Mathematics Education approach had a higher score compared with the achievements of students who are taught by traditional approaches.

**Analysis of Attitudes Test**

To determine the effects of RME approach on students attitudes, an analysis of students post-test mean scores of attitudes was carried out. This was to test hypothesis H<sub>02</sub>.

The results of one-way ANOVA test of students' attitudes toward mathematics indicated that F = .157 and p = 0.693 > .05. This means there is no significant difference between students in the control group and the students who were in the experimental group. Differences of mean for attitude toward mathematics is shown in Table 7.

Table 7: Mean differences for attitude towards mathematics

	SS	Df	MS	F	Sig
Between Group	.004	1	.004	.157	.693
Within Group	1.332	59	.023		
Total	1.336	60			

From the findings, it was concluded that the hypothesis  $H_{02}$  is not rejected. This means there is no significant difference between control group and the experimental group with regards to attitudes toward mathematics.

#### **4 Discussion**

##### **Mathematics Achievement**

The findings indicate that the null hypothesis is rejected. There is a mean difference between group who are taught with the Realistic Mathematics Education approach compared to students taught by traditional approaches. [25] suggests the process of developing concepts and ideas in mathematics should be related to the real world. RME bring students to the real world of everyday experience, so that lessons learned in the mathematics classroom is not separate from everyday life of students. The use of real world helps improve students' understanding of mathematical concepts that are abstract. The lessons involve everyday experiences of students and existing culture. This make learning more meaningful for students. The realistic mathematics education approach will help students understand concept and use these concepts in solving mathematics problems at a higher level.

Quality of teaching is very dependent on what teachers do in the classroom. By using Realistic Mathematics approach students are more active during the process of teaching and learning, the teacher act only as a facilitator for them. These findings support the study by [17] which states that RME can improve student achievement in Vietnam. He further said that the teaching using RME approach is consistent with the context of the culture in Vietnam. Study by [12]; [13]; [9]; [16] all showed that students taught by RME learn to be more active. Furthermore, all of the above study found that students develop understanding of mathematical concepts individually or in groups.

[14] conducted a study of students enrolled in a rehabilitation program and at the end of the study found that students who were taught with RME are better in performance. His study also found that students are able to recognize the mistakes made during the complete training after getting help from a teacher or other students who understand more. RME are also suitable for students at higher levels such as university students. [19]; [20]; [21] all showed that the teaching of mathematics using RME at the university can improve students' understanding of mathematical concepts and ultimately this study shows that student achievement increases.

##### **Students Attitudes Toward Mathematics**

Based on the analysis of the data, the results showed there was no significant difference between RME group and traditional groups. Thus, the hypothesis  $H_{02}$  is not rejected. All students have a positive attitude towards mathematics. They have already formed a positive attitude toward mathematics and the room to improve in terms of attitude is small. Six weeks of study may not be enough to influence the attitudes of students. A change in attitude can take a long time and the level of development of the attitude is different between each student [24]. These findings contradict the findings of a study conducted by [18]; [20]; [26]. These studies show that the use of realistic mathematics approach can influence students' attitudes toward mathematics.

#### **5 Conclusion**

The findings of this study have indicated that the use of Realistic Mathematics Education Approach can enhanced mathematics achievement of students. The results of this study to some extent provide information that students who are taught using Realistic Mathematics approach are better than students taught by traditional approaches. The results of this study are expected to provide guidance and real evidence to education community so that new policies can be implemented to improve the quality of education in the future. Teacher training institutions should also incorporate Realistic Mathematics Education in their curriculum so that trainee teachers can use the new approach when they become teachers in school.

## Conflict of Interests

The author(s) declare(s) that there is no conflict of interest regarding the publication of this article.

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