THE EFFECT OF REALISTIC MATHEMATICS EDUCATION WITH ROLE-PLAYING METHOD ON STUDENTS' MATHEMATICAL REPRESENTATION ABILITY

Tengku Karina Rafiela [1*], Ella Andhany [2]

[1,2]Departement of Mathematics Education, Universitas Islam Negeri Sumatera Utara, North Sumatra Province, Indonesia

*Correspondence: tengkukarina70@gmail.com

ABSTRACT

The decrease in students' mathematical abilities is caused by students' low interest or motivation in mathematics and the use of teaching approaches that are not suitable for students' learning styles, which is decreasing their interest in learning and struggling to understand mathematical materials. This quantitative study with experimental method aims to find out how influential RME (*Realistic Mathematics Education*) through role play method is on students' mathematical representation ability. A total of 66 students were positioned as research subjects. Data on students' mathematical representation ability was collected using a test of 5 description questions and analyzed using descriptive statistics in the form of averages and analytical statistics in the form of t-test (Independent Sample Test). The results showed a statistically significant difference between the mathematical representation ability of students who applied RME and students who only applied conventional learning. And if there is a difference then there is an effect of the treatment given to the experimental class. Following up on the findings in this study, RME with role-playing method has a positive effect on students' mathematical representation skills and can be applied in learning mathematics considering that it can encourage students to be actively involved and create a new circumstance in learning.
Keywords: RME, Mathematical Representation, Role Playing, Social Arithmetic

PRELIMINARY

One of the phenomena that has become a concern in the world of education in various countries including in Indonesia is the decline in mathematical ability in students. Mathematical abilities in students in Indonesia are low when compared to other countries, especially countries in ASEAN. This is based on the results of *Program for International Student Assessment* (PISA) survey in 2018 which determined that the ability of Indonesian students in the fields of mathematics, science, and reading was ranked low. Indonesia only reached 75th out of 81 countries in the world with a score of 379, far below Singapore, which has reached 2nd place and has a score of 569 (Singkam, et al, 2022). According to

PISA results, only 29% of Indonesian students reached at least level 2 in mathematics. However, according to *Trends in International Mathematics and Science Study* (TIMSS) survey results, Indonesian students ranked 45th out of 50 countries in mathematics skills, and in the 2015 PISA survey ranked 62nd out of 70 countries (Diana, et al, 2020).

Based on the results of the PISA survey, it can be concluded that there is a decrease in students' mathematical abilities. The focus of the problem from this phenomenon is the cause of the decrease in mathematical ability. The low mathematical ability of students can be caused by various factors, both internal and external. Some common causes of low student mathematical ability are: (1) Students' low interest or motivation in mathematics can affect their desire to learn and struggle to understand mathematical material (Lugosi & Uribe, 2022), (2) The use of teaching approaches that are not in accordance with students' learning styles can also have a negative impact on their understanding (Huang, et al, 2020). Students have a variety of different learning styles. If teaching methods do not match students' learning styles, so their understanding of mathematics can be affected.

After doing observations at Tunas Harapan Junior High School, the researcher found a problem that happened at the research location, that is student interest decreased when learning mathematics takes place. After interviewing some students of the class VII by asking questions about how the mathematics learning in the class has happened during this time, the researcher received some information about the learning methods used were the same every day, which were: (1) the lecturing method which is only centered on the teacher, (2) question and answer (from teacher to student), (3) and giving questions at the end of the lesson. If all of these things happen repeatedly, it will cause learning to become monotonous. The problem of monotonous learning approaches refers to a situation where the approaches used in the learning process tend to be routine, unvaried, and less interesting for students.

In teaching, usually the teacher will only use one method to be applied in learning. This is indeed commonplace in almost every school to shorten the time in the teaching process and not be a hard thing for the teacher. Teachers often have limited resources, both in terms of time and materials. Teaching with more than one method can take more time and preparation. Some teachers may tend to use the same teaching methods continuously without trying new approaches or variations that can make learning more interesting (Jumanta, 2016). They may feel comfortable in a certain way and be unwilling to try new approaches that may need additional effort. A learning approach or method that

is too monotonous is also caused by methods that are less adapted to the abilities and needs of students (Wulandari & Hendriani, 2021).

However, it is important to note that each student has different abilities and learning styles (Numonjonov, 2020). The material that the teacher teaches that day may be very easily accepted by most students. But, there are some other students who are very difficult to accept learning very well. The cause is because of various reasons, one of which is in terms of learning styles that are different from other students or just there is no interest and motivation in participating math learning. This is because students tend to be more motivated when the material is taught with a method that suits their learning style. In such conditions, it is better for teachers to try other ways of teaching that might be well followed by all students. Using various methods can help overcome learning blocks that students may have in understanding the material (Groover, 2020). By accommodating students' learning styles and adopting various learning methods, a teacher can create a learning environment that can help students understand the material more effectively and help students reach their potential better.

NCTM (National Council of Teachers of Mathematics) in 2000 mentioned there are five standards in the process of learning mathematics, that are: (1) Mathematical problem solving; (2) Understanding and communication of mathematical ideas (communication); (3) Proof and reasoning; (4) Mathematical representation; (5) Connecting and applying mathematics (connections). NCTM in 2000 also mentions five content standards in mathematics, that are: (1) numbers and their operations; (2) algebra; (3) geometry; (4) measurement; (5) data analysis and probability (Dewi, et al, 2015). At the beginning, NCTM only recommended four standards for the mathematics learning process, that are problem solving, reasoning, communication, and mathematical connections. Meanwhile, representation is still part of mathematical communication (Damayanti & Afriansyah, 2018). However, at all levels of education, there is always the ability to represent mathematics when learning mathematics, so it is seen that representation plays a vital part in the development of deep mathematical understanding (Goldin, 2020). Therefore, mathematical representation should be prioritized and instilled always when the mathematics learning process in schools is going on (Suningsih & Istiani, 2021).

During the mathematics learning process, this mathematical representation ability needs to be instilled because it is the ability of students needed to see or draw graphs, diagrams, or geometric models that help in understanding mathematical concepts visually (Umaroh & Pujiastuti, 2020). Mathematical representation also involves the use of

mathematical symbols and the right language to describe mathematical ideas (Sari & Sutirna, 2022), so in this case students are expected to be able to read, write, and interpret mathematical notation accurately. In this case, students will also relate concepts to real-life situations or apply these concepts in new situations (Sukaesih, et al, 2020), after firstly understanding abstract and complex mathematical concepts. And expected to be able to use logical thinking, find alternative solutions, or connect mathematical concepts with other knowledge.

In addition to being connected to other knowledge, mathematical concepts can also be applied to real situations (Abramovich, et al, 2019). One of them is by applying *Realistic Mathematics Education* (RME) in learning mathematics. RME is an approach to teaching mathematics that focuses on using the context of real situations in learning mathematics (Harahap & Lubis, 2019). Its main intention is to help students to make connections between the mathematics taught in the classroom to the situations and problems they face on a daily basis. This approach involves the use of problems derived from students' everyday activities, where students have to identify the mathematical problems within them, apply relevant mathematical concepts, and present a reasonable solution (Andriono, 2021). As such, it can encourage students to be built into creative problem solvers. Students are also required to communicate about mathematics in a real context. They must explain their mathematical thinking using appropriate language and present their solutions logically and coherently (Safitri, et al, 2021). Therefore, RME can help build students' mathematical representation ability by relating mathematics to the real world, improving concept recognition, practicing mathematical communication skills and mathematical problem solving skills.

Some research on RME has been done before. However, no report has been found that applies this role-playing method with money toy as media to find out how influential RME is on students' mathematical representation ability. Playing the role of sellers and buyers is expected to increase students' participation and motivation in learning mathematics through interactive and fun learning, and can improve students' communication skills when communicating their ideas and solutions to teammates. So that is suitable with the characteristics of RME. The money toy media is used to support the role playing with buying and selling themed. With this money toy media and buying and selling role-playing activities, students can learn about the importance of money, the value of things, the way to transact, and manage money. As well as achieving the goal of creating a fun and interactive game so that students can learn while playing.

The reports found are about how influential RME is on students' mathematical representation ability by using concrete media (Kusumaningrum & Nuriadin, 2022), but it was not clearly explained what media were used. In addition, most of RME approach were applied to improve mathematical communication skills (Nooryanti, et al, 2020; Astriani & Dhana, 2022; Jaswandi, at al, 2022), and RME that applied in the development of learning media that stimulate students' creative thinking skills (Pasaribu & Hasanah, 2022; Nastiti, et al, 2022).

This research aims to provide knowledge about the effect of RME by using the role-playing method on students' ability to represent a mathematical problem. Research like this should be implemented because it can support and motivate students to participate in learning more actively and be able to apply their knowledge in life. In addition, this research can be a new innovation for teachers to be able to provide more varied and more interesting teaching and can bring back students' enthusiasm in learning.

METHODS

This experimental study with a quantitative approach used a *Post-test Only Control Design*, which was conducted in the even semester of 2022/2023 academic year. All seventh grade students at Tunas Harapan Tanjung Anom Junior High School were involved as the research population. And the samples in this research, which were class VII-1 as the experimental class and class VII-2 as the control class, were selected by using *Simple Total Sampling* technique. Simple total sampling is a sampling method in research where the entire population or elements in the population are taken as the sample (Bhardwaj, 2019). This means that all members of the population are part of the sample, so no elements are excluded from the research. However, this method is only effective when the population to be researched is relatively small, so it is possible to collect data from all elements. By taking the entire population as a sample, the research results will provide exact and accurate information about the characteristics of the population as a whole without needing further statistical analysis (Mweshi & Sakyi, 2020).

Here, what is determined as the independent variable is the experimental class that applies RME and the control class that applies conventional approach, and what is determined as the dependent variable is the students' mathematical representation ability. The data to be taken is the result of a description question test which totals 5 questions and is done within 60 minutes. The assessment of the questions is set with standards based on indicators, that are: (1) students are able to present the steps of solution in words or written

text; (2) students are able to present the interpretation of a representation; (3) students are able to re-present data or information from the story form into a formula (mathematical notation) (Lestari & Yudhanegara, 2017). Perfectly, for each question if you answer by fulfilling the indicators: one (1) then get a score of 6; two (2) then get a score of 7; and three (3) then get a score of 7. So there are 20 points for each question number. The learning material in this study is: Social Arithmetic. For the purposes of this research, the treatment design for the research sample is:

Table 1. Treatment Design

Group	Independent Variable	Post Test
1	X	Q_2
2		Q_4

Description:

1   : Experimental Group

2   : Control Group

X   : Treatment (RME treatment in the experimental class)

Q_2 : Post-test of experimental class

Q_4 : Post-test of control class

The three steps of this research process are; preparation, implementation and conclusion.

(1) Preparation: Preparation begins with creating a research proposal, continued with creating research instruments including LKPD, lesson plans and post-tests. Validity and reliability tests were conducted before the test instruments were distributed to the experimental and control classes. As a valid instrument, the validity test was carried out based on the consideration of mathematics education experts and calculations with the formula *Person's Product Moment* correlation coefficient. This was done using SPSS program. Because the results of the comparison of r-count and r-table are the same, the questions are considered valid. Then, the reliability calculation is needed to determine whether the data can be considered reliable and whether *Cronbach's Alpha* value > r-table (0.70). The calculation result of 0.84 shows that the test instrument has a reliable status because the value is greater than the r-table. Based on the analysis of the test results, it can be concluded that each test question can be used to measure students' mathematical representation ability.

(2) Implementation: At this stage, researchers will carry out research activities in accordance with the design that has been prepared. This includes delivering the material, giving LKPD to students, applying role-playing method during learning, and organizing a post-test to measure student learning outcomes after being given the action. The test was given to each of the two sample classes. After the data were collected, the researcher analyzed the data by using homogeneity test and normality test to confirm that all data were normally and homogeneously distributed. Then, t-test (*Independent Sample Test*) was used as a statistical tool in this study by using SPSS program. This data analysis aims to answer research questions and identify if there is a change or influence from the given action.

3) Conclusion: At this stage, the researcher will interpret the results of the study to find answers on the research questions. These results will help to evaluate the effectiveness of the intervention or action taken in the study. Based on the results of the interpretation, the researcher will arrange the research conclusions and provide recommendations for the next research development or practical implications in the field of education.

RESULT AND DISCUSSION

Based on the research conducted at Tunas Harapan Tanjung Anom Junior High School, quantitative data was obtained in the form of post-test scores of students' mathematical representation abilities. Statistical calculations produced the following results:

Table 2. Descriptive Statistical Analysis Results

Posttest Results	N	Min	Max	Mean	Std. Deviation
Eksperimental	32	50	89	68,97	12,230
Control	34	34	78	56,41	13,306

According to the results of descriptive statistical analysis presented in table 2, the students' mathematical representation ability in the experimental class got an average score of 68.97 points, with a standard deviation of 12.230, and the average score of students in the control class got 56.41 points, with a standard deviation of 13.306. The mean scores showed a statistically significant increase in students' mathematical representation ability in the class that applied RME within it. The first evaluation of normality and homogeneity tests was necessary for the results of this research. *Shapiro-Wilk* test was used to check the normality of the data, while *Levene* test was used to check the homogeneity of the data in this research.

Table 3. Normality Test Results

	CLASS	Shapiro-Wilk		
		Statistic	df	Sig.
Posttest Results	Eksperimental	,939	32	,072
	Control	,944	34	,078

In table 3 the results of normality test by using *Shapiro-Wilk* test. Shapiro-Wilk test is one of the statistical methods used to test whether a sample of data comes from a normally distributed population, especially for small sample sizes (Le Boedec, 2016). Shapiro-Wilk test is appropriate for sample sizes <100. The result of the test show the significance (sig.) value in the experimental class of 0.072 and in the control class of 0.078. These results prove that the sig. value for both classes is more than 0.05. From these results, the research data was determined to be normally distributed. After the data was normally distributed, homogeneity test was conducted with *Levene* test.

Table 4. Homogeneity Test Results

		Levene Statistic	df1	df2	Sig.
Posttest Results	Based on Mean	,586	1	64	,447
	Based on Median	,470	1	64	,495
	Based on Median and with adjusted df	,470	1	63,8	,495
	Based on trimmed mean	,583	1	64	,448

Based on table 4 of homogeneity test results, it can be seen that the data is homogeneously distributed, because the significance value obtained is more than 0.05. As such, the data hypothesis can be tested with the t-test (*independent sample t-test*).

Table 5. Hypothesis Test Results

		Levene's Test for Equality of Variances				
		F	Sig.	T	Df	Sig.(2-tailed)
Posttest Result	Equal variances assumed	,586	,447	3,984	64	,000
	Equal variances not assumed			3,995	63,96	,000

Table 5 shows the results of hypothesis test with sig. (2-tailed) with a value <0.05, which is 0.000. Therefore, there is a statistically significant difference in students'

mathematical representation ability in class VII-1 taught with RME and students in class VII-2 with conventional learning. The results showed that realistic mathematics education with role-playing method had a positive effect on students' mathematical representation ability in class VII-1.

Some steps that can be taken in applying this role-playing method are:

Step one: give students roles or characters relevant to the given math situation. Students are divided into large groups of 6-7 members. Then, each of the large groups subdivides their members into 2 small groups, which are 3 people playing the role of sellers and 3 people playing the role of buyers. So in each large group there are sellers and buyers. After the small groups are divided, they will be given money toy as a media that will be used in this role play.

Step two: giving mathematical situations or problems that require students to use mathematical concepts in their roles. In this case, students will learn about mathematical concepts through relevant mathematical situations or problems and understand the concepts by using concrete examples and relating to their daily experiences. Before students play their roles as sellers and buyers, they will first be given the mathematics problems that they will play. Examples of these mathematics problems are taken from the practice problems on the LKPD (*Lembar Kerja Peserta Didik*).

Pak Ibnu mempunyai toko buku yang cukup besar di kota Ngabang. Di toko buku tersebut Pak Ibnu menjual kembali buku-buku yang dibelinya dari penerbit. Pak Ibnu membeli buku matematika dari penerbit dengan harga Rp35.000,00 per buku. Kemudian buku tersebut dijual lagi di toko bukunya dengan harga Rp40.000,00 per buku.

English version:

Mr. Ibnu owns a large bookshop in Ngabang city. In the bookshop, Mr. Ibnu resells books that he buys from publishers. Mr. Ibnu bought a maths book from a publisher at a price of Rp35,000 for each book. Then he resells the books in his bookshop for Rp40,000 for each book.

Figure 1. Example of Mathematics Problem

For the group of students who played the role as buyers, they were given several pieces of money toy (100 thousand, 50 thousand, 20 thousand, 10 thousand, 5 thousand, and 2 thousand), each of which totaled 5 pieces for each group.

Figure 2. Money Toy Media Used

Step three: motivating students to interact, discuss, and cooperate in groups in solving mathematics problems. Students play the role based on what has been distributed. They will buy items provided by the seller (in the form of stationery such as pens, notebooks, rulers, and so on) with the money they have been given. They must buy as much as possible until there is little money left and the item is sold out.

Figure 3. Students Play Role with Money Toy Media

The final step: observing and facilitating the learning process, guiding as needed. In this case, it can provide time for reflection after students have finished role-playing. Students can discuss their experiences while role-playing, students are also asked to discuss their understanding of mathematical concepts, and strategies used in problem solving. As a teacher, you can support students to share their ideas and solutions with their classmates. And do not forget to give feedback and guidance to help students improve their comprehension and ability.

This research has presented data on the effect of *Realistic Mathematics Education* with role-playing method on students' mathematical representation ability at Tunas Harapan Tanjung Anom Junior High School. In this research, several positive effects of *Realistic Mathematics Education* with role-playing method on students' mathematical representation ability were found, which are: (1) Development of conceptual ability; (2)

Active participation of students; (3) The use of real context; (4) Improvement of student communication.

Based on the data results, students' mathematical representation ability increased in the class that received RME treatment. In this context, there have been previous reports that examined RME which is influential in improving students' mathematical representation ability (Graciella & Suwangsih, 2016). Also, a report which explains the students' mathematical representation ability that are applied RME with the help of concrete media is higher than the class that is only applied conventional learning (Kusumaningrum & Nuriadin, 2022), and a report on the mathematics learning instruments developed through RME with the help of interactive CDs are valid and effective on student activeness when learning (Mutaqin, 2016). Another case is the research that examines the application of RME can improve students' ability in mathematical communication. Experimental class students who have been given learning by using RME, are more excellent in mathematics communication aspect if compared to students in the control class who are given conventional learning (Astriani & Dhana, 2022). The application of other learning approaches like inductive approach and CBSA (*Cara Belajar Siswa Aktif*) approach with DMR (*Discourse Multy Reprecentacy*) model can also have an effect to improve students' mathematical representation ability (Puspandari, et al, 2019; Angraini, 2019).

In role-playing method, students can participate in simulations of real situations like playing certain roles that involve mathematics. For example, they can play the roles of sellers and buyers in a store to practice the concepts calculation of price, return, or discount. In this role-playing process, students can experience directly how math is applied in daily life and develop a deeper understanding. Role-playing method often involves group work where students collaborate to play a role and solve a related math task or problem. In this group work, students can share ideas, thinking and strategies in solving math problems. They can also discuss the use of relevant mathematical representations and help each other in understanding mathematical concepts. Through role-playing method, *Realistic Mathematics Education* can be implemented in an interesting, interactive and relevant way. This method enables students to experience and apply mathematics in a real context, develop social skills, and deepen their understanding and representation ability in mathematics so that there will be interest and motivation to learn mathematics.

With so many benefits from the application of RME in mathematics learning, teachers should try to apply role-playing method to motivate students for being active and

create a new situation in learning, so that teachers are expected to be able to encourage students to be continue improve mathematical representation ability effectively, and make improvements to the experience of using role-playing method. And most importantly, improve the method to be more effective and suitable for students' needs.

CONCLUSION

In this study, it has been known how influential RME is on mathematical representation ability through the role-playing method, which is the statistically significant difference in students' mathematical representation ability who are applied RME and who are only applied conventional learning. The existence of a significant difference indicates the effect of RME treatment applied to the experimental class. So it can be concluded that *Realistic Mathematics Education* with role-playing method has a positive influence on students' mathematical representation ability. Descriptively, the positive effects, which are: (1) Development of conceptual ability; (2) Active participation of students; (3) The use of real context; (4) Improvement of student communication.

Despite the validation results that have been reported, specific limitations of this research should be noted. There are several limitations in this research which are (1) The limited sample of participants; and (2) The external factors that are difficult to fully control such as student attendance which will affect the internal validity of the research. (3) The lack of tools or media used in role playing.

Through the findings obtained, future research is expected to be able to complement the limitations or shortcomings that have been mentioned. Researchers should involve more research subjects by choosing schools that have more classes in order to involve participants from several sample classes. In addition, about student attendance, researchers can coordinate beforehand with the homeroom teacher to remind students to be present during the research process, especially when collecting student data that is needed in the research. As for those who are allowed not to attend, only students who are really unable to come to school, such as illness or misfortune. And finally, researchers should really prepare the media used in role playing. For example, making sales items from cardboard paper and so on.

In addition, the researcher recommends further research to implement RME with role-playing method in the classroom. RME creates interesting and varied roles for students. The researcher hope that the findings and recommendations from this research

can give a meaningful contributions to the development of innovative mathematics approaches and enable more interesting and effective mathematics learning in the future.

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