The Effect of the Realistic Mathematics Education Approach on Students' Mathematical Communication Skills

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Abstract

This quasi-experimental research was conducted to examine the influence of the Realistic Mathematics Education (RME) approach on students' mathematical communication abilities. The population of the study included all eighth-grade students of SMP Negeri 5 Bandar Lampung in the odd semester of the 2025/2026 academic year, consisting of 285 students. The research sample was determined through purposive sampling, involving class VIII.6 with 30 students as the experimental group and class VIII.7 with 31 students as the control group. The study applied a pretest–posttest control group design. Quantitative data on students' mathematical communication skills were collected using a written test. The data were analyzed using descriptive statistical techniques and inferential analysis with a t-test. The findings revealed that students taught using the RME approach demonstrated a greater improvement in mathematical communication skills compared to those who received conventional instruction. Thus, it can be concluded that the application of the RME approach has a significant positive effect on students' mathematical communication skills.

Keywords: *effect, mathematical communication skills, realistic mathematics education*

Introduction

Education as a fundamental foundation plays an important role in national development. Through education, individual potential can be developed optimally so as to improve the quality of human resources (Fitri, 2021). Education is also seen as a strategic effort in shaping the skills and abilities of citizens to create a dignified national civilization (Zakiyah, 2019). Thus, education is an important element in preparing a qualified future generation.

The importance of education is emphasized in Article 31 paragraph (1) of the 1945 Constitution of the Republic of Indonesia, which states that every citizen has the right to education. In line with this, Law No. 20 of 2003 on the National Education System emphasizes that national education aims to develop the potential of students to become people who are faithful, have noble character, are competent, creative, independent, democratic, and responsible. Therefore, formal education is organized in a structured manner to achieve these objectives.

Schools, as part of formal education, play a strategic role in improving the quality of human resources through a systematic learning process (Ansya, 2024). Formal education is carried out in stages, starting from primary education to higher education, with

the aim of equipping students with the knowledge, skills, and attitudes necessary for life in society.

One subject that plays an important role in formal education is mathematics. Mathematics is a compulsory subject taught at every level of education because it has broad benefits in everyday life (Hidayah, 2023). Mathematics also plays a role in shaping logical, systematic, and critical thinking through the use of meaningful symbols and representations (Ansya, 2024; Herawati, 2021). In addition, mathematics supports the development of science and technology as well as problem-solving skills (Laia, 2021).

The objectives of mathematics learning are designed to develop various mathematical abilities in students. The National Council of Teachers of Mathematics (NCTM, 2000) has established five process skills in mathematics learning, namely problem solving, reasoning and proof, connection, communication, and representation. In line with this, the Decree of the Education Standards, Curriculum, and Assessment Agency (BSKAP, 2025) emphasizes that mathematics learning aims to enable students to understand concepts, reason, solve problems, and communicate mathematical ideas clearly.

Mathematical communication skills are students' ability to understand and convey mathematical ideas through language, symbols, notation, and various forms of representation related to everyday life (Dianti et al., 2022). Lubis et al. (2023) state that mathematical communication skills enable students to transform contextual problems into mathematical models and explain the relationships between concepts orally and in writing. Through mathematical communication, students can convey their thought processes systematically and in an easily understandable manner (Nuraini et al., 2022).

Mathematical communication skills play an important role in mathematics learning. These skills help students build conceptual understanding, explain problem-solving strategies, and convey their thoughts to others. However, various studies show that students' mathematical communication skills in Indonesia are still relatively low (Suhenda & Munandar, 2023).

The low level of students' mathematical communication skills is reflected in the results of international studies. The results of the Trends in International Mathematics and Science Study (TIMSS) in 2015 show that Indonesian students' mathematics scores are far below the international average, particularly in the areas of application and reasoning (Sari, 2015; Noviyana et al., 2019). The low achievement in these aspects is related to students'

difficulties in explaining ideas, developing strategies, and representing mathematical thinking systematically (Wulandari et al., 2018).

Based on the 2022 Programme for International Student Assessment (PISA) study, the average mathematics score of Indonesian students was only 366 points, below the OECD average of 472 points (OECD, 2023). PISA questions measure mathematical literacy, including communication aspects that require students to express mathematical ideas and reasoning clearly (OECD, 2019). Thus, these low scores reflect the weak mathematical communication skills of students in Indonesia.

Low mathematical communication skills were also found among eighth-grade students at SMP Negeri 5 Bandar Lampung. Based on initial observations, students still had difficulty expressing mathematical ideas in writing, using symbols correctly, and explaining the steps to solve problems in a logical sequence. One of the factors contributing to low mathematical communication skills is the teacher-centered learning process. Conventional learning tends to provide fewer opportunities for students to express their opinions and communicate their mathematical ideas (Hidayah, 2023; Mahmuzah et al., 2017). In addition, students experience difficulties in using notation, drawing conclusions, and modeling contextual problems into mathematical form (Sibarani, 2022).

One learning approach that can be used to overcome these problems is the Realistic Mathematics Education (RME) approach. The RME approach emphasizes the use of contextual problems as a starting point for learning and encourages active student involvement in constructing mathematical concepts (Yuliani, 2020; Silvia, 2020). Through RME, students are guided to express mathematical ideas through symbols, pictures, diagrams, and other forms of representation related to real-life situations (Herawati, 2021; Septriansyah, 2023; Yovita, 2023). Based on the above description, this study aims to determine the effect of the Realistic Mathematics Education (RME) approach on the mathematical communication skills of eighth-grade students at SMP Negeri 5 Bandar Lampung in the 2025/2026 academic year.

Method

This study was conducted at SMP Negeri 5 Bandar Lampung in the odd semester of the 2025/2026 academic year. The population of this study was all eighth-grade students at SMP Negeri 5 Bandar Lampung, spread across nine classes, namely classes VIII.1 to VIII.9, excluding classes VIII.1 and VIII.2 because they were honor classes. Sampling was

conducted using purposive sampling. Based on the consideration of being taught by the same teacher and having relatively equivalent daily test scores and learning experiences, classes VIII.6 and VIII.7 were selected as the research samples. Class VIII.6 was designated as the experimental class with 30 students, while class VIII.7 was designated as the control class with 31 students.

This study is a quasi-experimental study that aims to determine the effect of implementing the Realistic Mathematics Education (RME) approach on students' mathematical communication skills. The research design used is a pretest–posttest control group design, involving two groups, namely the experimental group and the control group. The study was conducted at SMP Negeri 5 Bandar Lampung in the odd semester of the 2025/2026 academic year.

The population in this study included all 285 eighth-grade students at SMP Negeri 5 Bandar Lampung, spread across nine classes. The sample was selected using purposive sampling, taking into account the students' initial mathematical abilities and the similarity of their teachers. Based on these considerations, class VIII.6, consisting of 30 students, was designated as the experimental class that received instruction using the RME approach, while class VIII.7, consisting of 31 students, was designated as the control class that received conventional instruction.

Data collection was conducted using test techniques to measure students' mathematical communication skills. The instrument used was an essay test consisting of three questions on the subject of Two-Variable Linear Equation Systems. The test instrument was compiled based on indicators of mathematical communication skills, which included drawing, mathematical expression, and written text.

Before being used in research, the test instruments were pilot tested and analyzed in terms of content validity, reliability, discriminating power, and level of difficulty. The results of the analysis are presented in Table 1.

Table 1. Recapitulation of Instrument Testing Results.

No.	Validity	Reliability	Discriminating Power	Difficulty Level	Conclusion
1.	valid	0,79 (reliable)	0,46 (good)	0,67 (medium)	Used
2.			0,35(enough)	0,66 (medium)	
3.			0,44 (good)	0,51 (medium)	

The research procedure began with administering a pretest to the experimental class and control class to determine the students' initial mathematical communication skills. Next, the experimental class was given treatment in the form of learning using the RME approach, while the control class was given conventional learning. After the entire learning series was completed, both classes were given a posttest to obtain data on the students' mathematical communication skills after treatment.

The data obtained were analyzed using prerequisite tests, namely normality and homogeneity tests. The results of the prerequisite tests showed that the data on students' mathematical communication skills came from a normally distributed population and had homogeneous variance. Therefore, data analysis in this study used the t-test to determine the effect of the RME approach on students' mathematical communication skills.

Results and Discussion

This study aims to determine the effect of applying the Realistic Mathematics Education (RME) approach on students' mathematical communication skills. The research data were obtained from the pretest and posttest scores of students' mathematical communication skills in the experimental class, which received instruction using the RME approach, and the control class, which received conventional instruction. The pretest and posttest results are presented in Table 2.

Table 2. Posttest Data on students' mathematical communication skills.

Class	Number of Student	Mean	Lowest Score	Highest Score	Standard Deviation
RME	30	27,10	17	35	4,87
Conventional	31	25,13	17	31	4,08

Based on Table 2, it can be seen that the mean posttest score of students' mathematical communication skills in the RME class was higher than that of the conventional class. The RME class obtained a mean score of 27.10, while the conventional class achieved a mean score of 25.13. This result indicates that students who learned through the Realistic Mathematics Education approach demonstrated better mathematical communication skills than those who received conventional instruction. In addition, the standard deviation of the RME class was slightly higher than that of the conventional class, indicating that the distribution of scores in the RME class was more varied.

Before testing students' posttest scores in mathematical communication skills, prerequisite tests were conducted, including normality and homogeneity tests. The

normality test was performed using the chi-square (χ^2) test at a significance level of 0,05. The test results showed that the posttest data on students' mathematical communication skills in the experimental class ($\chi^2_{calculated} = 4{,}67 < \chi^2_{critical} = 7{,}81$) and control class ($\chi^2_{calculated} = 4{,}06 < \chi^2_{critical} = 7{,}81$) derived from a normally distributed population. Next, a homogeneity test was conducted using an F test at a significance level of 0,05. The test results showed that the value $F_{calculated} = 1{,}35 < F_{critical} = 2{,}08$, so it can be concluded that the variance of both classes is homogeneous.

Based on the results of the prerequisite test, data analysis was continued using a t-test to compare the average posttest scores for students' mathematical communication skills. The t-test results showed that the values $t_{calculated} = 1{,}96$ and $t_{critical} = 1{,}67$ so that $t_{calculated} < t_{critical}$ these results indicate that the average posttest scores for mathematical communication skills among students who participated in learning using the Realistic Mathematics Education (RME) approach were higher than those of students who participated in conventional learning. Thus, it can be concluded that the RME approach has a significant effect on students' mathematical communication skills.

The analysis of the percentage achievement of each mathematical communication ability indicator shows that students in the experimental class achieved a higher percentage than students in the control class. The achievement of mathematical communication ability indicators, which include written text, mathematical expression, and drawing, is presented in Table 3.

Table 3. achievement of indicators of students' mathematical communication skills.

Indicator	RME	Conventional Learning
Written Texts	91,94%	85,00%
Drawing	76,11%	72,22%
Mathematical Expression	57,78%	49,17%
Avarage	75,27%	68,79%

As shown in Table 3, the analysis of the achievement of mathematical communication ability indicators shows that the experimental class has an advantage in all indicators measured, namely drawing, mathematical expression, and written text. The average percentage of achievement of indicators in the experimental class reached 75.28%, higher than the control class at 68.80%. This advantage was consistently seen in each indicator, showing that learning with the Realistic Mathematics Education (RME)

approach not only improved overall results but also supported the development of all indicators of students' mathematical communication skills.

The achievement of students' mathematical communication skills in classes that apply the Realistic Mathematics Education (RME) approach is closely related to the effectiveness of implementing the RME learning stages, which include the use of real contexts, horizontal and vertical mathematization processes, as well as student discussion and reflection. All of these stages are integrated into learning activities through Student Worksheets (LKPD), which serve as a guide for students to understand problems and solve them in a structured manner (Batul, 2022; Halim, 2023).

In the first stage of learning, students are introduced to contextual problems that are relevant to their daily lives through worksheets. This stage encourages students to develop an initial understanding and express their ideas orally and in writing through group discussions. This process facilitates horizontal mathematization, which is translating contextual problems into pictures, tables, or simple mathematical models, so that students become accustomed to communicating mathematical ideas using their own language (Marium, 2019; Herawati, 2021).

Next, students develop the informal models they have created into more formal mathematical forms through a process of vertical mathematization. At this stage, students compose equations, perform calculations sequentially, and compare various solution strategies that arise within the group. This activity trains students to use mathematical symbols and expressions appropriately and to communicate their reasoning systematically (Batul, 2022; Halim, 2023).

The learning activity continued with a presentation of the group discussion results. Through the presentation, students conveyed the models, strategies, and solutions they had obtained, while other groups provided feedback. This interaction strengthened students' mathematical communication skills, both verbally, in writing, and visually, and increased their confidence in conveying mathematical ideas (Yuliani, 2020; Arafi & Masniladevi, 2020).

Based on the analysis of mathematical communication ability indicators, students who participated in RME learning showed higher results than students who participated in conventional learning on all indicators. On the written text indicator, the RME class achieved a percentage of 91.94%, higher than the conventional class at 85.00%. This

shows that students in the RME class are better able to explain mathematical ideas in writing using their own language in a coherent and clear manner (Yuliani, 2020).

On the drawing indicator, the RME class achieved a percentage of 76.11%, while the conventional class achieved 72.22%. This achievement shows that RME learning encourages students to use visual representations such as pictures, diagrams, or graphs in explaining mathematical problems. The use of real-world contexts in RME helps students connect problems with relevant visual representations (Herawati, 2021; Hidayah, 2023).

Meanwhile, on the mathematical expression indicator, the RME class obtained a percentage of 57.78%, higher than the conventional class at 49.17%. These results indicate that students who learn with the RME approach are more skilled at writing symbols, equations, and mathematical expressions accurately. The horizontal and vertical mathematization processes in RME help students move from informal understanding to formal representation in stages (Halim, 2023; Julie et al., 2014).

Based on the above discussion, the application of learning with the Realistic Mathematics Education (RME) approach provides greater opportunities for improving students' mathematical communication skills compared to conventional learning. Through learning stages designed to actively involve students in observing contextual problems, discussing, modeling, and communicating their thoughts, students are trained to express mathematical ideas in written, visual, and symbolic forms. These findings are in line with the research by Arafi and Masniladevi (2020) and Herawati (2021), which states that the RME approach can improve students' mathematical communication skills because it emphasizes active involvement, discussion, and the use of real contexts in the learning process. Thus, the RME approach not only focuses on the final learning outcomes but also accustoms students to communicate their mathematical thinking processes systematically and meaningfully.

Conclusion and Suggestion

Based on the results of the research and discussion, it can be concluded that the application of the Realistic Mathematics Education (RME) approach has an effect on the mathematical communication skills of seventh-grade students at SMP Negeri 5 Bandar Lampung in the odd semester of the 2025/2026 academic year, where students who participated in learning using the RME approach showed a higher increase in mathematical communication skills compared to students who participated in conventional learning. In

this regard, future researcher are expected pay attention to effective time management so that RME learning can run optimally, while future researchers are encouraged to prepare Student Worksheets (LKPD) with language that is easy to understand, a number of questions that are appropriate for the time allocation, and provide more opportunities for students to practice presentations, so that students' mathematical communication skills, self-confidence, and active participation can develop to their fullest potential.

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