The Impact Application of Realistic Mathematics Education on Problem-Solving Ability and Mathematical Communication of Elementary School Students

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Abstract. The low achievement of problem-solving and mathematical communication skills of elementary school students in Mathematics lessons is the background of this research. The selection of learning models by teachers is a consideration to minimize and overcome the low problem-solving and mathematical communication skills of students in Elementary School Mathematics. Realistic Mathematics learning efforts are thought to be a teacher's solution to minimize and overcome the low problem-solving and mathematical communication skills of elementary school students in the field of Mathematics. Thus, the researcher's goal is to create this article to review the impact of applying Realistic Mathematics Learning on elementary school students' problem-solving and mathematical communication skills. Researchers use the systematic literature review method. The subject of this study consists of 10 research articles from 2019 to 2022. The technique in this study is the documentation technique. The research instrument is a list of data sequences based on the classification of research materials based on the focus of the study and the format of the record. The results of this study prove that the application of Realistic Mathematics Learning positively impacts elementary school students' problem-solving and mathematical communication abilities.

Keywords: Realistic mathematics education, problem-solving, mathematical communication.

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INTRODUCTION

Nowadays, mathematics is one of the sciences that students need to master, especially at the elementary school level (SD), with the hope of achieving mathematics skills (Warsito et al., 2018). Must arrange learning activities in detail to challenge students to think critically to solve mathematics problems (Zulkardi et al., 2020; Tong et al., 2022; Khairun Nisa & Muhtar, 2022). Thus, the selection of learning strategies at the elementary level needs to be considered as a support for teachers and students to achieve optimal learning indicators. Realistic Mathematics Education (RME) is one type of mathematics learning technique that can give students space to make it easier to understand the material. RME is a learning model from the Netherlands with a particular mathematics theory. Characteristics of RME have problem situations from the real world, fantasy fairy tales / formal mathematics as long as the problem is really in the student's thinking (Van den Heuvel-Panhuizen & Drijvers, 2020). Learning using RME starts with contextual issues, which lead to the field of mathematics (Arnellis et al., 2020). Through RME, teachers teach mathematics material related to activities in students' daily lives (Purna et al., 2021). Based on these three expert opinions, RME is a mathematical theorizing learning model characterized by contextual problems through the real world, fairy tale fantasies/formal mathematics at the learner's beginning related to daily life activities.

RME has advantages, including that mathematics will be close to the student's living environment, making it easier to understand the material in the field of mathematics (Hidayatullah & Ekawati, 2021). Through RME, teachers can minimize the emergence of boring situations in mathematics learning activities (Hidayatullah & Ekawati, 2021). RME motivates elementary school teachers to make mathematics learning student-centered (Hidayanthi, 2022). Thus, learning using RME will make it easier for teachers to explain mathematical material and make it easier for students to understand the material using the context of daily life that is natural in student thinking. Sabandar in Ariawan & Nufus (2017) stated that in addition to students needing to understand mathematics learning materials, elementary school students also need

problem-solving and mathematical communication skills. Students' ability to solve problems, of course, to understand and solve problems (Saja'ah, 2018). As for mathematical communication skills, students can easily communicate orally through communicating when discussing and in writing by expressing mathematical ideas in pictures, equations, graphs, and diagrams, in student language (Rasyid, 2019). One of the causes of the low ability to solve problems and mathematical communication in elementary mathematics is that students have difficulty learning mathematics because teachers create a mathematics learning process without adequate explanation (Novita et al., 2022).

Therefore, the author reviewed various articles with the suspicion that RME impacts elementary school students' problem-solving and mathematical communication skills in mathematics learning. So the focus of this article is a review of the impact of the application of RME on elementary school students' ability to solve problems and mathematical communication. The author's purpose in conducting this review is to determine the impact of applying RME on elementary school students' problem-solving ability and mathematical communication**.**

METHOD

Researchers use the systematic literature review research method, which is the collection of various research results from study publications based on the search, analysis, and reporting of available reference sources and then adjusted to answer research questions (Xiao & Watson, 2019). The subjects of this study are ten research articles published in reputable journals from 2019 to 2022. The source of this research is based on secondary data, namely sources that provide a variety of data inconsistently through other documents/people (Helaluddin & Wijaya, 2019). The author uses data collection techniques in the form of documentation, which is a way of collecting various data that involves analyzing the contents of written documents to make conclusions based on research criteria (Mahmudah, 2021). Researchers use research instruments in the form of a list of data sequences with the classification of research materials based on the focus of the study and the format of notes (Putri & Ariani, 2020).

RESULTS

The application of the procedure for identifying a study aims to prevent analysis of the discovery data results from the fallacy of a theory. The author reviewed ten articles using a quasi-experimental and descriptive qualitative research method related to the impact of the application of RME on problem-solving and mathematical communication skills of elementary school students in Indonesia, namely as follows:

Mathematical Problem-Solving Ability

Table 1. Improving Mathematical Problem-Solving Ability in Grade 2 Students of SDN (State Elementary School) Kukuh Pagi

The Average Score of The Problem-Solving Ability	
Experiment Class	Control Class
Average Postest Value	Average Postest Value
70.33	32.40

Table 1 data are the results of a study using the quasi-experimental method of posttest-only control design by Herdiansyah & Purwanto (2022) on 90 grade 2 students of SDN Kukuh Pagi regarding the application of RME to the ability to solve mathematical problems about the material of addition and subtraction calculation operations.

Table 2. Improving Mathematical Problem-Solving Ability in Grade 4 Students of SD In Pati Regency

The Average Score of The Problem-Solving Ability			
Experiment Class		Control Class	
Average Pretest Value	Average Postest Value	Average Pretest Value	Average Postest Value
65.80	84.81	63.42	71.89

Table 2 data are the results of a study using the quasi-experimental method of pretest-posttest control group design by Rohim et al. (2021) on 115 grade 4 students of SD in Pati Regency regarding the application of RME to the ability to solve mathematical problems about flat wake material.

Table 3. Improving Mathematical Problem-Solving Ability in Grade 5 SDK (Christian Elementary School) Students of Wae Mata

The Average Score of The Problem-Solving Ability			
Experiment Class		Control Class	
Average Pretest Value	Average Postest Value	Average Pretest Value	Average Postest Value
64.51	81.71	63.75	75.87

Table 3 data are the results of a study using the quasi-experimental method of pretest-posttest control group design by Ndiung (2021) on 41 grade 5 students of SDK Wae Mata regarding the application of the RME model to improve the ability to solve mathematical problems about fractional materials.

Table 4. Improving Mathematical Problem-Solving Ability in Grade 5 Students of SDN 01 Manisrejo

The Average Score of The Problem-Solving Ability			
Experiment Class		Control Class	
Average Pretest Value	Average Postest Value	Average Pretest Value	Average Postest Value
63.33	76.67	68.21	67.14

Table 4 data are the results of a study using the quasi-experimental method of pretest-posttest control group design by Chairunisa et al. (2022) on 52 grade 5 students of SDN 01 Manisrejo regarding the application of RME to the ability to solve mathematical problems about space building materials.

Table 5. Improving Mathematical Solving Ability in Grade 5 Students of SD Mardi Yuana

The Average Score of The Problem-Solving Ability			
Experiment Class		Control Class	
Average Pretest Value	Average Postest Value	Average Pretest Value	Average Postest Value
46.25	82.29	44.79	80.21

Table 5 data are the results of a study using the quasi-experimental method of pretest-posttest control group design by Widiastuti & Nindiasari (2022) on 72 grade 5 students of SD Mardi Yuana regarding the application of RME to the ability to solve mathematical problems about speed material.

Mathematical Communication Skills

Table 6. Improving Mathematical Communication Skills in Grade 2 Students of SDN Moroko

Average Score of Mathematical Communication Ability	
Average Pretest Value	Average Postest Value
50.30	77.30

Table 6 data is the result of a study using a qualitative method of qualitative descriptive design by Rusmiati & Ruqoyyah (2021) on 15 grade 2 students of SDN Moroko regarding the application of the RME model to improve mathematical communication skills in mathematics learning about the material of measuring the weight of objects.

Table 7. Improving mathematical communication skills in grade 3 students of SD Kristen Kalam Kudus

Average Score of Mathematical Communication Ability	
Experiment Class	Control Class
Average Postest Value	Average Postest Value
73.60	66.89

Table 7 data are the results of a study using the Quasi-experimental method Posttest-Only Control Design by Astuti et al. (2020) on 25 grade 3 students of SD Kristen Kalam Kudus regarding the application of the RME model to improve mathematical communication skills in mathematics learning about mixed counting operations.

Table 8. Improving Mathematical Communication Skills in Grade 4 Students of SDN 09 Bengkulu City

Average Score of Mathematical Communication Ability			
Experiment Class		Control Class	
Average Pretest Value	Average Postest Value	Average Pretest Value	Average Postest Value
38.46	78.42	35.00	59.13

Table 8 data are the results of a study using the quasi-experimental method Pretest-Posttest Control Group design by Atikah et al. (2020) on 48 grade 4 students of SDN 09 Bengkulu City regarding the application of the RME model to improve mathematical communication skills in mathematics learning about circumference and flat building area.

Table 9. Improving Mathematical Communication Skills in Grade 4 Students of SDN 2 Kebonpedes

Average Score of Mathematical Communication Ability			
Experiment Class		Control Class	
Average Pretest Value	Average Postest Value	Average Pretest Value	Average Postest Value
59.60	84.60	57.60	66.60

Table 9 data are the results of a study with the quasi-experimental method of pretest-posttest control group design by Nurjanah et al. (2022) on 50 grade 4 students of SDN 2 Kebonpedes regarding the application of the RME model to improve mathematical communication skills in learning mathematics about fractional material.

Table 10. Improving Mathematical Communication Skills in Grade 5 Students of SDN Citapen

Average Score of Mathematical Communication Ability			
Experiment Class		Control Class	
Average Pretest Value	Average Postest Value	Average Pretest Value	Average Postest Value
33.09	71.32	26.67	61.55

Table 10 data, namely the results of a study using the quasi-experimental method of pretest-posttest control group design by Febriani et al. (2019) on 34 grade 5 students of SDN Citapen regarding the application of the RME model to improve mathematical communication skills in mathematics learning about the material of multiplication and fractional division calculation operations.

DISCUSSION

Based on the data analysis of ten research articles, the scope of articles about the impact of RME on mathematical communication skills and solving elementary mathematics problems is obtained, namely the following:

Mathematical Problem-Solving Ability

Mathematical problem-solving skills are widely researched using RME, especially in elementary schools. The results of the research by Herdiansyah & Purwanto (2022) in table 1, the implementation of RME for 90 grade 2 students of SDN Kukuh Pagi there was an increase in the ability to solve mathematical problems in the material of addition and subtraction calculation operations. After students learn mathematics with the RME model, data from the experimental class post-test is obtained, namely 70.33. Meanwhile, data from the control class postest that applies conventional methods without RME is 32.40. In addition, elementary school students in experimental classes using RME have been shown to improve mathematical problem-solving skills in addition and subtraction calculation operations.

The results of the research by Rohim et al. (2021) in table 2, the implementation of RME for 115 grade 4 students of SD in Pati Regency, show an increase in the problem-solving ability of flat wake materials. Based on experimental class data, students got an average pretest score of 65.80. After that, students learn mathematics with the RME model to get data on the average post-test score of 84.81. Meanwhile, in the control class, data from student pretests received an average score of 63.42. After that, students learn mathematics with conventional methods without RME, so the average post-test score data is 71.89. Thus, elementary school students in experimental classes using the RME model have been shown to improve mathematical problem-solving skills in flat building materials.

The results of the research by Ndiung (2021) in table 3, the implementation of RME for 42 grade 5 students of SDK Wae Mata, show there was an increase in the problem-solving ability of fractional materials. Based on experimental class data, students get an average pretest score of 46.25. After that, students learn mathematics with the RME model to get data on the average post-test score of 82.29. Meanwhile, in the control class, data from student pretests obtained an average score of 44.79. After that, students learn mathematics with conventional methods without RME so that post-test average score data is obtained, which is 80.21. Thus, elementary school students in experimental classes using the RME model have been proven to improve their ability to solve mathematical problems in fractional materials.

The results of the research by Chairunisa et al. (2022) in table 4, the implementation of RME for 52 grade 5 students of SDN 01 Manisrejo, showed an increase in the problem-solving ability of space-building materials. Based on experimental class data, students get an average pretest score of 63.33. After that, students learn mathematics with the RME model to get data on the average post-test score of 76.67. Meanwhile, in the control class, data from student pretests obtained an average score of 68.21. After that, students learn mathematics with the conventional method without RME, so the post-test average score data is 67.14. Thus, elementary school students in experimental classes using the RME model have been proven to improve their ability to solve mathematical problems in spatial building materials.

The results of the research (Widiastuti & Nindiasari, 2022) in table 5, the implementation of RME for 72 grade 5 students of SD Mardi Yuana, show an improvement in the ability to solve problem material speed. Based on experimental class data, students get an average pretest score of 46.25. After that, students learn mathematics with the RME model to get data on the average post-test score of 82.29. Meanwhile, in the control class, data from student pretests obtained an average score of 44.79. After that, students learn mathematics using the conventional method without RME so that the post-test average score data is obtained, which is 80.21. Thus, elementary school students in experimental classes using the RME model have been proven to improve their ability to solve mathematical problems in speed material.

Mathematical Communication Solving Capabilities

Mathematical communication skills have been researched using RME, especially in elementary schools. The results of a study by Rusmiati & Ruqoyyah (2021) in table 6, the implementation of RME for 25 grade 2 students of SDN Morocco there, showed an improvement in the mathematical communication ability of material measuring objects. It is based on data from Pretest, which is 50.30. After that, students learn mathematics with the RME model so that post-test data is obtained, which is 77.30. In this way, it is proven that there is an increase in mathematical communication skills in measuring objects using RME for elementary school students.

The results of the research by Astuti et al. (2020) in table 7, the implementation of RME for 25 grade 3 students of SD Kristen Kalam Kudus, show there was an improvement in mathematical communication skills of mixed counting operation materials. This is based on data from Pretest, which is 66.89. After that, students learn mathematics with the RME model so that post-test data is obtained, which is 73.60. In this way, it is proven that there is an increase in mathematical communication skills in mixed calculation operation materials using the RME model for elementary school students.

The results of the research by Atikah et al. (2020) in table 8, the implementation of RME for 24 grade 4 students of SDN 09 Bengkulu City was an improvement in mathematical communication skills of circumference and flat building area. Based on experimental class data, students get an average pretest score of 38.46. After that, students learn mathematics with the RME model to get data on the average post-test score of 78.42. Meanwhile, in the control class, data from student pretests received an average score of 35.00. After that, students learn mathematics with conventional methods without RME, so the post-test average score data is 59.13. In this way, it is proven that there is an increase in mathematical communication skills in the perimeter and flat building area materials using the RME model for elementary school students.

The results of the research by Nurjanah et al. (2022) in table 9, the implementation of RME for 25 grade 4 students of SDN 2 Kebonpedes, show there was an improvement in the mathematical communication ability of fractional materials. Based on experimental class data, students get an average pretest score of 59.60. After that, students learn mathematics with the RME model to get data on the average post-test score of 84.60. Meanwhile, in the control class, data from student pretests obtained an average score of 57.60. After that, students learn mathematics using conventional methods without RME, so the post-test average score data is 66.60. In this way, it is proven that there is an increase in mathematical communication skills in fractional materials using the RME model for elementary school students.

The results of the research by Febriani et al. (2019) in table 10, the implementation of RME for 34 grade 5 students of SDN Citapen there, showed an improvement in the mathematical communication ability of the material of calculating multiplication and fractional division operations showed. Based on experimental class data, students get an average pretest score of 33.09. After that, students learn mathematics with the RME model to get data on the average post-test score of 71.32. Meanwhile, in the control class, data from student pretests obtained an average score of 26.67. After that, students learn mathematics with the conventional method without RME, so the post-test average score data is 61.55. In this way, it is proven that there is an increase in

mathematical communication skills in the material of multiplication calculation operations and fractional division using the RME model for elementary school students.

Based on a review of all ten articles, it is thus evident that applying RME positive impacts problem-solving in elementary schools on the material of addition and subtraction calculation operations, flat build, space building, speed, and fractions. Then, applying RME also positively impacted elementary school students' mathematical communication skills in measuring the weight of objects, mixed counting operations, flat wake circumference, flat wake area, and fractional counting operations. Experimental classes with RME are better than control classes because they cause an increase in the motivation of students' thought processes to solve mathematical problems, increase curiosity about topics that are not yet understood, there is collaborative interaction through discussion, connect problems with the concepts of daily life, and have high enthusiasm when learning. Control classes with conventional methods without RME make students bored and saturated. So Learning using RME can make it easier for elementary school students to receive mathematics material, significantly improving problem-solving skills and mathematical communication. Research (Turmudi & Maulida, 2019) shows that using RME is proven to trigger elementary school students to improve their problem-solving skills and mathematical communication. In addition, the use of RME can trigger an increase in concept understanding, learning motivation, self-confidence, and student learning outcomes (Lestari et al., 2020; Sinaga et al., 2020; Sari et al., 2022).

CONCLUSION

Based on the results and discussions, there were many trials of ten studies for elementary school students in Indonesia. The impact of Realistic Mathematics Education can trigger students' active responses in the learning process as a result of Learning being connected with actual activities of students' daily lives. This makes it easier for elementary school students to construct, understand the material, and improve their communication skills in mathematics lessons. Thus, it is proven that the application of Realistic Mathematics Education has a positive impact on improving the problem-solving and mathematical communication skills of students from elementary schools in the field of mathematics.

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