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LITERATURE REVIEW: THE EFFECTIVENESS OF THE REALISTIC MATHEMATICS EDUCATION APPROACH TO IMPROVE STUDENTS MATHEMATICAL COMMUNICATION SKILLS

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ABSTRACT

Communication is one of the important skills that students must have in mathematics. Engaging in communication activities helps provide an understanding of mathematical communication skills to students. However, in reality, students' mathematical communication skills are still in the low category. Therefore, a more interactive learning method is needed. This study was conducted to analyze the effectiveness of the Realistic Mathematics Education (RME) approach in improving mathematical communication skills.The method used in this research is a literature review with inclusion and exclusion criteria focusing on studies containing quantitative or qualitative data. The data collection technique involved gathering relevant National and International Journal articles published between 2019 and 2023. From the numerous articles found, researchers selected 21 articles related to this study. The data processing technique applied in this study examined the effectiveness of using Realistic Mathematics Education (RME) to improve communication skills in the collected articles. The results showed that RME is an effective learning approach for improving students' mathematical communication skills. In addition to Realistic Mathematics Education (RME), classroom learning can be enhanced with various media, such as Audio Visual Media or Learner Worksheets (LKPD). This approach makes classroom learning more interactive and receives positive responses from students, helping them understand the material better by expressing mathematical ideas through oral and written language and making arguments with confidence.

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INTRODUCTION

Education is a process of transferring knowledge, developing skills, and shaping attitudes through learning experiences aimed at fostering holistic development in individuals and preparing them to effectively participate in society. Within education, various fields can be taught and developed, such as mathematics. Mathematics, often regarded as the queen servant of science, contributes to various scientific branches by developing theories and applications. In school settings, mathematics is applied to explore students' potential and characteristics in relation to the material studied, aligning with technological and informational advancements through interactive communication (Melawati, 2020). Communication is a crucial ability that students must possess in mathematics. Engaging in communication activities helps students develop mathematical communication skills. According to Permendiknas Number 22 of 2006, the goal of learning mathematics is for students to articulate ideas and arguments using symbols, tables, diagrams, and other media to explain problems. This communication aspect is termed mathematical communication. Mathematical communication, defined in the Intended Learning Outcomes (Swari et al., 2019), refers to the ability to express mathematical ideas clearly to peers, teachers, and others through oral and written language. This skill enables students to interpret and articulate their understanding of learned concepts more effectively.The National Council of Teachers of Mathematics (NCTM, 2000) emphasizes that mathematics education aims to enhance students' ability to communicate mathematically, as it is integral to the learning process and is a key standard in the Mathematics Learning Process Standards (Ariani, 2017). Parinata & Puspaningtyas (2022) further assert that communication skills in mathematics facilitate the exchange of thoughts and ideas, thereby enhancing understanding and knowledge during the learning journey. Mathematical communication skills are crucial for students to effectively convey ideas and consolidate thoughts (Melawati, 2020).

However, in the 2018 PISA (Program for International Student Assessment), Indonesia's ranking declined, with mathematical ability ranked 7th from the bottom, achieving an average score of 379 out of 487. This indicates that the mathematical abilities of students in Indonesia are low, including their mathematical communication ability. As a result, many students still perceive math as a difficult subject, leading to low mathematical communication skills. This is also supported by Maharani & Ramlah (2021) in their research conducted in junior high schools, which found that students' mathematical communication in school is still not optimal. The lack of students mathematical communication skills can be attributed to learning methods that often make students bored. Additionally, Nuraeni & Afriansyah (2021) stated that students mathematical communication skills are still low because students lack the courage to express opinions and ideas, lack the confidence to present their work, and cannot solve problems by expressing them in the form of pictures or diagrams. Mathematical communication skills are very important for students to possess. Therefore, to improve these skills, it is necessary to enhance mathematics learning. One alternative is to use a learning approach that involves students more, such as the Realistic Mathematics Education (RME) approach. RME is a learning method developed by Freudenthal, a mathematician and mathematics educator in the Netherlands (Fachrurazi & Safriyanti, 2020). The RME approach utilizes everyday life problems to help students build abstract abilities. In teaching, students are encouraged to focus on real situations, which can improve their skills in solving mathematical problems effectively.

Based on the description above, it can be concluded that learning using the RME approach to improve students communication skills needs to be further explored. It is hoped that more varied learning activities can enhance students communication skills. Therefore, research was conducted through a literature review to determine the effectiveness of the application of the

Realistic Mathematics Education (RME) approach on students mathematical communication skills.

METHOD

The research method used in this study is a literature review, which involves several stages: searching for reference sources, determining inclusion and exclusion criteria, identification, analysis, and evaluation. The inclusion and exclusion criteria for this study are based on the results and discussion sections, which contain quantitative or qualitative data or literature reviews that show an improvement in communication skills. Reference sources were obtained by collecting national journal articles and international journals published between 2019 and 2023, all of which have ISSNs. From the many articles collected, the researchers selected 21 articles that had significant relevance to the keywords used. The researchers then limited the scope of the selected references to include the Realistic Mathematics Education (RME) approach and communication skills. This research went through several processes, as illustrated in the following diagram:

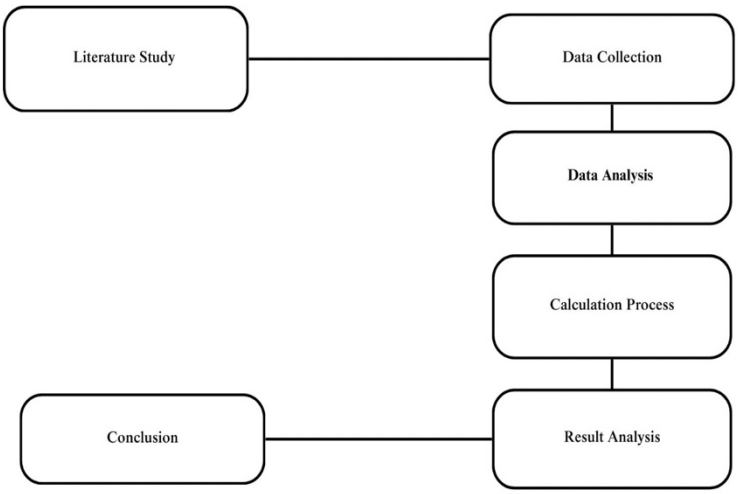

Figure 1. Literature Review Research Flow Diagram

This study aims to provide more detailed information about the effectiveness of the application of the Realistic Mathematics Education (RME) approach in improving students mathematical communication skills through a qualitative descriptive method.

RESULTS AND DISCUSSION

Results

The results of this study were compiled by analyzing and summarizing various sources regarding the Realistic Mathematics Education (RME) learning approach with inclusion and exclusion criteria.

Table 1. Results of RME Research on Mathematical Communication Skills

No	Researcher	Research Result
1	Efektivitas Penerapan Model Pembelajaran *Realistic Mathematics Education* (RME) terhadap Kemampuan Komunikasi Matematika	The research conducted shows that RME learning is effective in improving the mathematical communication skills of junior high school students in Grade VIII.

	Siswa (Lubis, et al., 2023)	
2	Pengaruh Pendekatan *Realistic Mathematics Education* (RME) terhadap Kemampuan Komunikasi Matematis Siswa Kelas VIII SMP Negeri 8 Bukittinggi (Septriansyah, et al., 2023)	After learning with the RME approach, Grade VIII students in the Bukittinggi area experienced a significant increase in their mathematical communication skills.
3	Pengembangan Media Ular Tangga dengan Model *Realistic Mathematics Education* (RME) pada Pemahaman Konsep Matematika (Akhidah et al., 2023)	The results showed that the media used with the RME approach was categorized as feasible and proved to be effective for classroom use.
4	Lembar Kerja Siswa Berbasis *Realistic Mathematics Education* (RME) untuk Memfasilitasi Kemampuan Komunikasi Matematis Siswa Pengembangan (Nur & Fitri, 2023)	The results of the data analysis showed that the LKPD based on the RME approach was considered very valid, practical, and effective in improving students communication skills.
5	Dampak Penggunaan Pendekatan *Realistic Mathematics Education* (RME) terhadap Kemampuan Komunikasi Matematis Siswa Sekolah Dasar (Arrahim & Pangesti, 2023)	This research, using the literature review method, states that the application of the Realistic Mathematics Education approach can improve students' ability to communicate mathematically.
6	Peserta Didik pada Pembelajaran Matematika Realistik: Studi Kepulauan Berbasis Potensi Pesisir (Palinussa & Ngilawajan, 2023)	Showed that coastal-based RME learning is more effective and influential than conventional RME learning.
7	Pengembangan Media Interaktif Matematika Berbasis RME Menggunakan Adobe Animate untuk Pembelajaran Materi Rasio dan Proporsi (Faiq & Fiangga, 2023)	The results of the analysis show that designing learning media using the RME approach, by integrating the principles and characteristics of RME into the material and interactive quizzes, is proven to improve students mathematical communication skills.
8	Kemampuan Komunikasi Matematis Siswa Kelas VIII pada Pola Bilangan melalui Pendekatan *Realistic Mathematics Education*	Data analysis showed that students mathematical communication skills improved significantly with the application of the RME approach in one of the secondary schools in Aceh.

	(RME) (Nazira et al., 2023)	
9	Application of Realistic Mathematics Education (RME) To Improve The Students Mathematical Communication Ability (Harahap & Sari, 2022)	After carrying out a series of activities starting from the pretest, treatment, and posttest, it can be concluded that the use of RME was effective in improving mathematical communication skills, as seen from the N-Gain acquisition for each sampled class.
10	Pengaruh Model Realistic Mathematic Education Berbantuan Media Audio Visual terhadap Kemampuan Komunikasi Matematis Siswa Sekolah Dasar (Nurjanah et al., 2022)	Learning with the Realistic Mathematics Education (RME) approach, aided by audio-visual media, has a significant impact on improving students' mathematical communication skills.
11	Improving mathematical communication skills with the application of a realistic mathematics education approach (Wahyuni & Rejeki, 2022)	This research shows that students' communication skills improve after implementing learning with the application of RME, as evidenced by an increase in their ability indicators.
12	Matematika Berbasis *Realistic Mathematics Education* (RME) untuk Meningkatkan Kemampuan Komunikasi Matematis Siswa Materi Bilangan Bulat Kelas VII SMP Swasta Esa Prakarsa Selesai (Henniwati, 2021)	The effectiveness of RME-based mathematics learning media in improving students' communication skills is evident from the positive response of students during the learning process.
13	Pengaruh Pendekatan CTL dan RME terhadap Kemampuan Penalaran dan Komunikasi Matematis Siswa (Ramadhani, Lisa & Johar Rahmah, & Ansari, 2021)	This research shows that students' involvement in learning mathematics with the RME approach yields positive results in improving mathematical communication skills.
14	Kemampuan Komunikasi Matematik Siswa Kelas II SD pada Materi Mengkur Berat dengan Menggunakan Pendekatan *Realistic Mathematics Education* (RME) (Rusmiati & Ruqoyyah, 2021)	The results of this study showed that teachers and students gave positive responses to the learning materials in the classroom after using realistic learning. As a result, students' learning outcomes improved, particularly in their mathematical communication skills.
15	Peningkatan Kemampuan Matematik dan Self Efficacy Siswa dengan Menggunakan Pendekatan Matematika	This study showed that the use of the realistic mathematics approach resulted in better and more effective mathematical communication skills among students. RME is also used as an alternative to help

	Realistik (Durrotunnisa & Nur, 2020)	improve communication skills and self-efficacy in learning mathematics.
16	Penerapan Model Pembelajaran *Realistic Mathematics Education* (RME) untuk Meningkatkan Kemampuan Komunikasi Matematis Menggunakan Lembar Kerja Siswa (Melawati, 2020)	The use of contextual problems in the implementation of Realistic Mathematics Education helps teachers guide students purposefully and more effectively.
17	The Effect of RME on Mathematics Learning Outcomes Viewed Mathematic Communication Skills (Ningrum, Reni., Gunarhadi., 2020)	There are differences in mathematics learning outcomes among students who have high, medium, and low mathematical communication skills after learning with the RME approach.
18	The Implementation of Realistic Mathematics Education Approach to Improve Students' Mathematical Communication Ability in Statistics Course (Paroqi et al., 2020)	The results show that there is an increase in mathematical communication skills among students in statistical studies using Realistic Mathematics Education (RME) learning.
19	Pendekatan Pendidikan Matematika Realistik terhadap Hasil Belajar Matematika Siswa Sekolah Dasar (Khotimah & As'ad, 2020)	Students who learn using a realistic mathematics approach achieve higher average learning outcomes.
20	Design of worksheets for RME model to improve mathematical communication (Supriyanto et al., 2020)	This study resulted in the design of worksheets for students using the RME approach to improve their mathematical communication skills.
21	Penerapan Model Pembelajaran *Realistic Mathematics Education* (RME) untuk Meningkatkan Kemampuan Komunikasi Matematis Siswa pada Siswa Kelas Viii Di SMP Negeri 2 Tarutung (Saragih, 2019)	After implementing Realistic Mathematics Education learning in Class VII, students are able to provide explanations, arguments, and present information in the form of tables, figures, and graphs.

Discussions

Based on the results of the study, the Realistic Mathematics Education (RME) approach proved to be effective in improving the mathematical communication skills of grade VIII students (Lubis, et al., 2023). By applying the RME approach, there was a significant

improvement (Septriansyah, et al., 2023). Additionally, the media used with RME was declared very feasible and effective (Akhidah, et al., 2023). Furthermore, the use of LKPD (Student Worksheets) based on the RME approach was found to be effective in improving communication skills (Nur & Fitri, 2023), and LKPD can also make it easier for teachers to guide students in the learning process. Beyond RME-based LKPD, coastal-based RME learning also positively influenced mathematical communication skills (Palinussa & Ngilawajan, 2023). Realistic Mathematics Education (RME) has a significant impact on mathematical communication skills (Arrahim & Pangesti, 2023; Nazira et al., 2023; Wahyuni & Rejeki, 2022; Henniwati, 2021). Learning that uses RME provides opportunities for students to take a more active role and enhances their enthusiasm in the learning process, leading to better mathematical communication skills (Habibi & Novita, 2023; Ramadhani, Lisa & Johar Rahmah, & Ansari, 2021; Rusmiati & Ruqoyyah, 2021). Faiq & Fiangga (2023) state that use of media developed with RME principles and characteristics also the experimental group concluded that the average value of students increased after learning with RME. The difference in mathematics learning outcomes between students who have high, medium, and low mathematical communication skills also appears to improve after participating in learning using RME (Ningrum, Reni., Gunarhadi., 2020). Also the results show that there is an increase in mathematical communication skills among students in statistical studies using Realistic Mathematics Education (RME) learning (Paroqi et al., 2020).

Of the several studies conducted, the study that caught my attention regarding the effectiveness of the RME approach in improving communication skills was titled "Application of Realistic Mathematics Education (RME) To Improve The Students Mathematical Communication Ability" (Harahap & Sari, 2022) because after carrying out a series of activities starting from the pretest, treatment, and posttest, it can be concluded that the use of RME was effective in improving mathematical communication skills, as seen from the N-Gain acquisition for each sampled class. Then the second is research with the title "*Pengaruh Model RME berbantuan Media Audio Visual terhadap Kemampuan Komunikasi Matematik Siswa Sekolah Dasar*", After conducting several experiments that resulted in positive changes, audio-visual media was found to be effective in improving students' mathematical communication skills. Audio-visual media, which involves both sound and image elements, engages the senses of sight and hearing during learning. This effectiveness is evidenced by significant improvements in students mathematical communication skills measured through test instruments, comparing the RME approach assisted by audio-visual media with ordinary learning (Nurjanah et al., 2022). The last one is research by Durrotunnisa & Nur (2020), in their study *"Peningkatan Kemampuan Komunikasi Matematik dan Self-efficiacy Siswa dengan Menggunakan Pendekatan Matematika Realistik",* state that besides mathematical communication skills, the psychological factor of self-efficacy also significantly impacts the development of one's talent. Their research shows that the application of the Realistic Mathematics Education (RME) approach facilitates students in developing both communication skills and self-efficacy in understanding and solving mathematical problems.

CONCLUSION

Based on the results of the analysis and discussion, the RME approach is an effective learning method for teaching mathematics to students from elementary school to high school. Realistic Mathematics Education (RME) focuses on realistic problems from daily life, enabling students to understand the material through their mathematical communication skills. This is demonstrated by students ability to present and explain problems using pictures and arguments. Therefore, the RME approach is considered to elicit positive responses and improve students mathematical communication skills.

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