

SYSTEMATIC LITERATURE REVIEW: REALISTIC MATHEMATICS EDUCATION APPROACH FOR ENHANCING JUNIOR HIGH STUDENTS' CRITICAL THINKING SKILLS

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Article History	Abstract. In the era of globalization, critical thinking skills in mathematics are
-	essential. However, mathematics is often perceived as difficult and monotonous,
Received: 15-03-2025	prompting the need for teachers to employ engaging approaches, such as Realistic Mathematics Education (RME). RME connects mathematical concepts
Revision: 17-04-2025	with real-life situations to enhance students' understanding and critical thinking skills. This study aims to analyze affectiveness of PME in improving iunior high
Accepted: 29-04-2025	school students' critical thinking skills through a Systematic Literature Review
Published: 08-05-2025	(SLR) using the PRISMA approach. Data were confected from articles published between 2015 and 2025 in the WoS and Scopus databases, with 26 articles identified. The results indicate a growing number of RME-related publications, peaking in 2023 (10 articles). The most common research method was quasi- experimental (54%), with geometry as the primary topic (6 studies). Implemented strategies included e-worksheets, RME-based teaching materials, RME learning media, and RME learning models. This study confirms the effectiveness of RME in enhancing students' critical thinking skills. Keywords: PRISMA, Systematic Literature Review, Realistic Mathematics Education, Critical Thinking Skills
	Abstrak. Di era globalisasi, keterampilan berpikir kritis dalam matematika sangat penting. Namun, matematika sering dianggap sulit dan membosankan, sehingga guru perlu menggunakan pendekatan yang menarik, seperti <i>Realistic</i> <i>Mathematics Education</i> (RME). RME menghubungkan konsep matematika dengan kehidupan sehari-hari untuk meningkatkan pemahaman dan keterampilan berpikir kritis siswa. Penelitian ini bertujuan untuk menganalisis efektivitas RME dalam meningkatkan keterampilan berpikir kritis siswa SMP melalui metode <i>Systematic Literature Review</i> (SLR) dengan pendekatan PRISMA. Data dikumpulkan dari artikel yang diterbitkan antara 2015–2025 dalam database WoS dan Scopus, dengan 26 artikel teridentifikasi. Hasilnya menunjukkan peningkatan publikasi RME, dengan puncak pada 2023 (10 artikel). <i>Quasi-Experiment</i> adalah metode paling umum (54%), sementara geometri menjadi topik utama (6 penelitian). Strategi yang diterapkan meliputi e-worksheet, bahan ajar RME, media pembelajaran RME, dan model pembelajaran RME. Penelitian ini menegaskan efektivitas RME dalam meningkatkan keterampilan berpikir kritis siswa.

Kata Kunci: PRISMA, Tinjauan Literatur Sistematis, Pendidikan Matematika Realistis, Kemampuan Berpikir Kritis

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INTRODUCTION

Mathematics education plays a crucial role in developing students' critical thinking skills, particularly at the junior high school level. Critical thinking is one of the key competencies required in the era of the Fourth Industrial Revolution and Society 5.0, where students are expected to analyze, evaluate, and solve problems independently and creatively (Alam et al., 2023). In mathematics learning, the approach used by educators significantly influences students' development of critical thinking skills (Kintoko et al., 2025). One approach that has gained widespread attention in mathematics education is Realistic Mathematics Education (RME), which emphasizes the connection between mathematical concepts and real-life situations, enabling students to develop a deeper understanding of mathematical concepts (Manggarrani et al., 2024).

The RME approach was first developed in the Netherlands by the Freudenthal Institute and has been widely implemented in various countries, including Indonesia. RME asserts that mathematics is not merely a collection of formulas and procedures but a human activity that can be constructed through exploration and contextual problem-solving (Rohmadi et al., 2024). This approach is believed to enhance students' critical thinking skills by encouraging them to discover mathematical solutions through exploring various strategies and relating them to reallife situations (Siswanto & Andriyani, 2024). Therefore, it is essential to systematically examine how RME can be effectively used to improve junior high school students' critical thinking skills.

Critical thinking skills in mathematics encompass various aspects, such as analysis, evaluation, inference, and reflection (Facione, 2011). Students with strong critical thinking skills tend to identify patterns, understand relationships between concepts, and solve problems using more systematic and creative approaches. Several studies have shown that problem-based learning and contextual approaches such as RME contribute positively to improving students' critical thinking skills (Anwar, 2024). However, despite numerous studies, more in-depth and systematic research is needed to understand the extent of RME's effectiveness in enhancing critical thinking skills, particularly at the junior high school level.

Systematic reviews in educational research, particularly in mathematics teaching approaches, are essential for understanding research trends and identifying patterns that can be adopted in teaching practice (Awang et al., 2025). Using the Systematic Literature Review (SLR) method, this study will examine previous research on the implementation of RME in improving junior high school students' critical thinking skills. SLR is a systematic, transparent, and replicable approach to reviewing literature, providing a comprehensive understanding of

the effectiveness of a teaching approach (Siswanto & Peni, 2023). Previous studies have indicated that the RME approach contributes to enhancing students' conceptual understanding and critical thinking skills across various educational levels (Koerunnisa et al., 2025). However, most of these studies remain limited in scope, and few have specifically examined the effectiveness of RME in the context of secondary education. Therefore, a more in-depth analysis of the existing literature is necessary to identify key findings, challenges, and opportunities for implementing RME in junior high schools.

Furthermore, the implementation of RME in junior high school mathematics education still faces various challenges, such as teachers' limited understanding of RME principles, lack of learning resources supporting this approach, and differences in students' ability to comprehend mathematics through real-world contexts (Taqiya & Juandi, 2023). Therefore, by systematically reviewing previous studies, this research is expected to provide more targeted recommendations for educators and researchers in developing more effective RME-based teaching strategies to enhance junior high school students' critical thinking skills.

In the context of Indonesia's curriculum, the RME approach aligns with the Merdeka Belajar concept, which emphasizes flexible, contextual, and student-centered learning (Kemendikbudristek, 2022). Thus, understanding the effectiveness of RME in improving students' critical thinking skills can contribute to the development of a more relevant teaching model that meets Indonesia's educational needs. Based on the discussion above, this study aims to systematically review existing research on the RME approach in enhancing junior high school students' critical thinking skills. By conducting a Systematic Literature Review (SLR), this research is expected to provide a deeper understanding of RME's effectiveness and identify challenges and recommendations that can be applied in mathematics education at the junior high school level.

METHOD

Research design

This study primarily explores the Realistic Mathematics Education (RME) approach in enhancing high school students' critical thinking skills. Through a comprehensive literature review, it aims to develop a thorough understanding of the existing framework while identifying areas for further exploratio. By consolidating, analyzing, and integrating various relevant sources, the study facilitates the assessment of specific hypotheses or the formulation of new theories. Employing the Systematic Literature Review (SLR) methodology, the research focuses on self-efficacy and its significance in mathematics education. It adopts the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework (Parums, 2021), which includes a four-phase flow diagram for identifying, screening, determining eligibility, and including studies within the review scope. Particular emphasis is placed on quantitative aspects, such as the number of studies included and excluded. The application of the PRISMA approach assists researchers in selecting relevant studies based on their research questions and outlines the steps for identifying studies aligned with the research needs related to implementing the RME approach to enhance students' critical thinking skills.

Study Procedure

The research articles used in this study consist of publications from the Web of Science (WoS) and SCOPUS databases, with publication years ranging from 2015 to 2025. This timeframe allows us to focus our review on the most recent literature, considering the retrieval and synthesis of information in the digital era. Accordingly, each database and specific search criteria related to the topic were carefully selected. Initially, the topics were explored, followed by an examination of abstracts to determine their relevance to the study. If a study met the initial criteria, its full text was retrieved for a comprehensive review and evaluation. The keywords used in the search process included "Realistic Mathematics Education" and "Critical Thinking Skills".

Inclusion and Exclusion Criteria

The data collection process was conducted by selecting articles from various academic databases, following the PRISMA flowchart as outlined below.



Figure 1. PRISMA flow

Based on the figure above, the number of articles identified through keyword searches was 203 (n = 203), while those found through references and manual searches totaled 112 (n = 112). The excluded articles, as shown in Table 1, amounted to 54 (n = 54), and the discarded records numbered 121 (n = 121). The number of screened articles was 67 (n = 67), and after the screening process, 67 articles (n = 67) remained eligible. From the articles used for research analysis, only 26 articles (n = 26) were selected, while 41 articles (n = 41) were excluded due to the lack of full text or irrelevance of the title to this study. The selection criteria were applied through filters and specific keyword searches using the advanced search features on designated database websites. The inclusion criteria covered articles published between 2015 and 2025. Excluded articles included those published before 2015 and those that were not part of journals or conference proceedings. The selected articles had to be directly related to the implementation of the Realistic Mathematics Education approach to enhance high school students' critical thinking skills.

Criteria	Inclusion	Exception
Publication Time	2015-2025	2014 and earlier
Document Type	Article	Books, book chapters, modules
Туре	Journal	Non-journal
Subject	Mathematics subjects	Non-mathematics

Table 1. Criteria for accepting and rejecting articles

Data Analysis

Data collection was carried out by extracting the title, year, number of articles per year, type of research used, subjects studied, and efforts to enhance critical thinking in mathematics learning. Thematic analysis was employed to categorize each article that correlated with this study. The PRISMA method consists of several stages, including identification, screening, eligibility, and inclusion. Understanding this method provides a fundamental skill set for qualitative researchers, enabling them to apply other approaches in data analysis. Additionally, thematic analysis is a configurative approach that involves multiple activities, including interpretation as an ongoing process throughout data analysis and synthesis (Basarir-Ozel et al., 2022; Siswanto et al., 2024).

RESULTS

The Realistic Mathematics Education (RME) approach is considered effective in learning mathematics because it can encourage students to think critically. This is due to the characteristics of RME which emphasizes realistic aspects in learning, so that students are more

active in the learning process. The data used in this research has gone through stages in accordance with PRISMP provisions. The final results of the analysis resulted in 26 new study reports included in this research.

Author	Year	Research Result
Dhayanti et al.	2018	Application of Realistic Mathematics Education Using Geometer's Sketchpad in proportion material can improve students' critical and creative thinking
Oktaviani et al.	2018	Based on the post-test results, it can be seen that the critical thinking ability of experimental class students with an average score was 76.84 with a standard deviation of 6.96, while in the control class the average was 72.75 with a standard deviation of 11.64.
Ramadani	2019	It is hoped that using the RME learning approach will have an influence on critical mathematical thinking abilities
Suparman & Wijayanti	2019	The results of the research show that the feasibility test of the material has an average score of 89. Thus, designing student worksheets with a realistic mathematical approach is quite promising.
Arnellis et al.	2020	We conclude that implementing a Realistic Mathematics Education approach that focuses on critical thinking skills improves learning outcomes. The average score of the experimental class on the topic of calculus was higher than the control class, with post-test results showing a significance of $0.00 > 0.05$
Hikayat et al.	2020	This research resulted in the design of an RME-based module that can improve students' critical thinking skills using the ADDIE development method
Utarni & Mulyatna	2020	The application of RME learning with the MEA strategy increases students' critical thinking skills, shown by an increase in the average score of 28%, from 56% in cycle I to 84% in cycle II
Arisoy & Aybek	2021	Education in the experimental group using the RME approach had a positive influence on students' critical thinking skills
Sofyan et al.	2021	Achievement and improvement of students' mathematical critical thinking skills with the contextual-based video-assisted RME approach is better than with the RME approach alone
Asmara et al.	2022	Students who undergo RME-based learning show greater improvement in critical mathematical thinking skills compared to those taught using expository methods
Putri et al.	2022	The average critical thinking abilities of control and experimental class students were 72.61 and 84.74 respectively, with the t test showing $4.264 > 2.00$, so the RME approach had an effect on mathematical critical thinking abilities
Samura et al.	2022	The results of the analysis show that the application of RME innovation can improve junior high school students' critical thinking skills

Table 2. Presenting and comparing selected articles

F '1 (1	2022	
Farida et al.	2022	The findings of this study indicate that the RME-based teaching
		materials developed are valid, practical, and effective in enhancing
		critical thinking skills
Hendrajah et al.	2023	In conclusion, the validation results underline that RME-based
		RPPs and worksheets are powerful educational resources that meet
		strict criteria of validity, practicality and effectiveness
Herlinda et al	2023	The results of this research show that the average pretest and
Hermida et al.	2023	nostest scores for students' mathematical critical thinking abilities
		in the experimental class were 52.52 and 82.40 respectively, with
		In the experimental class were 32.32 and 33.40 respectively, with hypothesis testing producing a sig (2 toiled) value of 0.000 < 0.05
	2022	The set of
Some et al.	2023	The results of the research show that the application of the LSLC-
		based RME model is able to improve students' critical thinking
		skills with the level of critical thinking of students in the
		experimental class being greater than the control class.
Wahyuni et al.	2023	The ability to think critically with the RME learning method has a
-		more significant influence than conventional learning
Ismaimuza et al.	2023	There are significant differences and interactions between learning
		approaches and students' mathematical critical thinking abilities
		based on their initial mathematics knowledge and self-efficacy
Handraich at al	2022	The validation results confirm that the DME based DDD and LVDD
Hendrajan et al.	2023	The valuation results contribution has the KiviE-based KFF and LKFD
		are valid, practical and effective learning resources, so they have
		the potential to support the optimal application of RME in
		mathematics learning
Lestari et al.	2023	The research results show that the worksheet developed is suitable
Lestari et al.	2023	The research results show that the worksheet developed is suitable in terms of validity, practicality and effectiveness
Lestari et al.	2023 2023	The research results show that the worksheet developed is suitable in terms of validity, practicality and effectiveness This research shows that RME learning based on Riau Malay
Lestari et al. Lubis & Fitri	2023 2023	The research results show that the worksheet developed is suitable in terms of validity, practicality and effectiveness This research shows that RME learning based on Riau Malay culture can improve students' mathematical critical thinking skills,
Lestari et al.	2023	The research results show that the worksheet developed is suitable in terms of validity, practicality and effectiveness This research shows that RME learning based on Riau Malay culture can improve students' mathematical critical thinking skills, making learning more fun and meaningful
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Based on previous research which is summarized in the table above and used as a reference in this Systematic Literature Review (SLR) research, it is clear that the RME approach can encourage students to think critically.

Total of ARTICLES EACH YEAR

The total of articles per year based on table 2 above can be seen in the following figure.



Figure 2. Total articles each year

Based on total article data per year, in 2018 and 2019 there were 2 articles each. This number increased slightly in 2020 with 3 articles, but stagnated again at 2 in 2021. Furthermore, there was an increase in 2022 with a total of 4 articles, and a significant spike occurred in 2023 with 10 articles. However, in 2024, the number of articles will decrease again to 3. This data shows that there are fluctuations in the number of articles published each year, with the highest peak in 2023.

Type of Research Used

The researcher presents a diagram illustrating the various types of research used to analyze whether the RME approach has an effect on students' critical thinking abilities. The percentage of research types that discuss the Realistic Mathematics Education approach includes several methods, such as Classroom Action Research (CAR), development research, and quasi-experiment. This percentage can be seen in the following figure.



Figure 3. Percentage of research type

Based on the figure above, it shows the percentage of various types of research used in studies related to the Realistic Mathematics Education (RME) approach. The most dominant type of research is quasi-experimental with a proportion of 54%, which shows that most studies use this method to measure the effectiveness of RME. Research and Development (RnD)-based research covers 34% of the total research, indicating that there is significant effort in developing approaches and teaching materials related to RME. Meanwhile, qualitative research only contributed 8%, which shows that there is still relatively little descriptive analysis of the implementation of RME. Finally, Classroom Action Research (CAR) has the smallest portion, namely 4%, indicating that this approach is rarely used in evaluating RME.



Mathematics topics used in research

Figure 4. Mathematical topics

The image above shows the distribution of the various mathematical topics studied. The most discussed topic is geometry, with a total of 6 studies, indicating that this concept has great attention in the study of mathematics. Statistics and straight lines each have four studies, followed by systems of linear equations in two variables and lines and angles, which each have three studies. Meanwhile, sets, social arithmetic, probability and rectangular shapes are topics with the least amount of research, namely only one or two studies. This distribution reflects the main focus of mathematics research, with geometry being the most dominant topic compared to the others.

Efforts to Increase Critical Thinking in Mathematics Learning Using the RME Approach

The researcher outlines various efforts to enhance critical thinking skills in mathematics learning through the Realistic Mathematics Education (RME) approach. One such effort is the use of electronic student worksheets. Well-designed e-worksheets can help students understand the material more effectively by providing summaries and assignments that support conceptual comprehension (Astiwi & Siswanto, 2024; Hatmoko et al., 2024). Additionally, e-worksheets can be presented in the form of Google Forms, allowing students to easily access materials and review lessons. Teachers can also include images or relevant photos to clarify assignments (Syah et al., 2025; Tarso et al., 2025). The practicality and effectiveness of RME-based e-worksheets have been proven to enhance students' understanding during the learning process.

In addition to e-worksheets, the use of RME-based teaching materials is another strategy to foster students' critical thinking. Well-designed teaching materials can make learning more engaging compared to conventional lecture, question-and-answer, and discussion methods. Teaching materials that have been validated for their effectiveness can be used in classrooms as an innovative approach to mathematics learning, making it easier for students to grasp the concepts being taught. The RME learning model embedded in these materials has been shown to encourage students to think more critically when solving problems (Koerunnisa et al., 2025).

The use of RME-based learning media also plays a role in improving the quality of instruction. One such medium is manipulative media, such as origami paper, which can be crafted into various shapes according to the subject matter being taught. This approach has been shown to enhance students' critical thinking skills by up to 88.9% (Amalia et al., 2019). Additionally, contextual video-based media serves as an effective alternative to making learning more interactive and increasing student engagement. Videos featuring moving images with sound can strengthen students' memory and understanding of the material. Contextual

videos that relate mathematical concepts to real-life situations have been proven to significantly improve students' comprehension (Aprilia et al., 2025; Syah et al., 2024).

Finally, the implementation of the RME learning model serves as a key strategy in enhancing the effectiveness and efficiency of the learning process. This model emphasizes realistic concepts that allow students to visualize and interpret mathematical material based on their everyday experiences. Through this approach, learning becomes more meaningful, and the concepts being taught are more easily retained in students' memories. The RME model also aids students in understanding mathematical concepts in a more contextual and applicable manner, thereby increasing their absorption of the material delivered by teachers.

DISCUSSION

The Realistic Mathematics Education (RME) approach has been widely researched and implemented in mathematics education as an effective method for enhancing students' critical thinking skills. Research findings indicate that this approach emphasizes the use of realistic contexts, allowing students to connect mathematical concepts with their everyday experiences. Consequently, students become more active in exploring and understanding mathematical concepts, ultimately contributing to the improvement of their critical thinking skills. A study conducted by Arisoy & Aybek (2021) found that students who learned using the RME approach showed significant improvements in critical thinking skills compared to the control group. Similar results were observed by Arnellis et al. (2020) in their research on calculus, where the experimental class utilizing RME achieved significantly higher post-test scores than the control class. This suggests that the RME approach not only aids in understanding mathematical concepts but also enhances students' critical thinking abilities.

Furthermore, research by Asmara et al. (2022) revealed that students learning geometry through the RME approach demonstrated better critical thinking skills than those using the expository method. This finding is supported by Dhayanti et al. (2018), who discovered that integrating Geometer's Sketchpad in RME-based learning can enhance both students' critical and creative thinking skills. Thus, the RME approach offers flexibility in integrating various learning media to improve students' comprehension of mathematical concepts. A study by Firmansyah (2024) demonstrated that the development of RME-based animated video learning media could enhance students' critical thinking skills in social arithmetic topics. This underscores the importance of utilizing technology in RME-based learning to further facilitate student engagement in understanding mathematical concepts. Additionally, research by Hendrajah et al. (2023) highlighted the significance of developing valid, practical, and effective

RME-based lesson plans and worksheets to support the successful implementation of this approach in classrooms. According to a study by Putri et al. (2022), the RME approach had a positive impact on students' critical thinking skills in statistics learning. This finding was reinforced by Samura et al. (2022), who found that innovations in the implementation of RME significantly improved students' critical thinking skills at the middle school level. These results indicate that RME can be applied across different educational levels to enhance student learning outcomes.

A study by Sofie et al. (2023) showed that the RME approach, when integrated with the Lesson Study Learning Community (LSLC) model, led to a significant improvement in students' critical thinking skills, particularly at levels 3 and 4 of critical thinking. Additionally, Wahyuni et al. (2023) confirmed that the RME approach had a more substantial impact on improving critical thinking skills compared to conventional teaching methods. These findings suggest that the RME approach is not only effective in enhancing conceptual understanding but also in shaping students' critical thinking patterns.

Based on the analysis of previous studies summarized in this Systematic Literature Review (SLR), it can be concluded that the RME approach effectively enhances students' critical thinking skills across various mathematical topics. The diversity of research findings demonstrates that this approach can be implemented in various learning contexts, whether through technology-based media or RME-based teaching materials. Therefore, this approach holds great potential for continuous development and implementation in mathematics education to improve the quality of learning in the future.

CONCLUSION

Based on the results of this Systematic Literature Review (SLR) research, 26 articles were identified as research sources. In the period from 2015 to 2025, the number of articles discussing the RME approach has increased, with a peak in 2023 reaching 10 articles. The various types of research used include Classroom Action Research (CAR), quasi-experimental research found most frequently in research reaching 54%, geometry material is material that has been extensively researched reaching 6 studies, and various efforts have been made to improve students' critical thinking skills, including through the use of e-worksheets, RME-based teaching materials, RME learning media, and RME learning. The research results show that the RME approach is effective in improving students' critical thinking skills.

RECOMMENDATIONS

Educators are advised to adopt more RME-based strategies, such as the use of eworksheets, RME open materials, and interactive learning media, to improve student understanding. In addition, further research can explore the application of RME to other materials and develop integrative methods to improve its effectiveness in various learning contexts.

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