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REALISTIC MATHEMATICS EDUCATION MODEL TO IMPROVE MATHEMATICAL PROBLEM-SOLVING: A SYSTEMATIC REVIEW

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Abstract: Mathematical problem-solving remains a fundamental competency in mathematics education, yet many students continue to experience difficulties in developing this skill. The Realistic Mathematics Education (RME) model has been widely recognized as an approach that connects mathematical concepts to real-life contexts, potentially enhancing students' problem-solving abilities. This study aims to systematically review the effectiveness of the RME model in improving mathematical problem-solving skills. A systematic literature review was conducted by analyzing peer-reviewed articles published between 2017 and 2026, indexed in reputable databases such as Scopus and SINTA. The selection process followed inclusion and exclusion criteria to ensure the relevance and quality of the studies. The findings indicate that the RME model consistently shows a positive impact on students' mathematical problem-solving, particularly in fostering conceptual understanding, active engagement, and contextual reasoning. Furthermore, several studies highlight its role in reducing students' anxiety and improving learning motivation. In conclusion, the RME model is an effective and relevant approach for enhancing mathematical problem-solving skills, especially when integrated with contextual and student-centered learning strategies.

Keywords: mathematical problem-solving; realistic mathematics education; student engagement; systematic literature review

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INTRODUCTION

Mathematics education plays a vital role in developing students' higher-order thinking skills, particularly their ability to solve complex problems systematically and logically. Mathematical problem-solving is recognized as one of the most essential competencies that students must acquire in order to navigate academic challenges and apply mathematical reasoning in real-world situations. Despite its critical importance, research consistently documents that students at various levels of education struggle to develop proficiency in this area, often due to an overemphasis on procedural memorization rather than conceptual

understanding and contextual application. This persistent difficulty underscores the need for innovative pedagogical approaches that situate learning within meaningful contexts.

Realistic Mathematics Education (RME) is an approach to mathematics teaching that was originally developed by Hans Freudenthal at the Freudenthal Institute in the Netherlands during the late 1960s and 1970s. The fundamental premise of RME holds that mathematics should be a human activity that is grounded in realistic, experiential contexts rather than abstract formalism. In this framework, students are guided to reinvent mathematical concepts through a process of guided inquiry in which real-world problems serve as the starting point for mathematical exploration. This philosophy distinguishes RME from conventional approaches, which typically begin with formal definitions and rules that students are expected to apply mechanically. The use of contextual problems in RME not only makes learning more meaningful but also fosters deeper engagement and intrinsic motivation among students.

In Indonesia, the adaptation of RME is known as PMRI (Pendidikan Matematika Realistik Indonesia), which has been integrated into the national curriculum reform efforts over the past two decades. PMRI retains the core principles of RME while incorporating local cultural contexts and Indonesian educational values, making it a culturally responsive approach to mathematics instruction. The implementation of PMRI in Indonesian schools has been accompanied by growing empirical research examining its effectiveness across different grade levels, subject matter, and student populations. However, the fragmented nature of this body of research has made it difficult to draw comprehensive and generalizable conclusions about the impact of RME on mathematical problem-solving competencies.

A Systematic Literature Review (SLR) provides a rigorous and transparent methodology for synthesizing evidence from multiple primary studies in order to arrive at more reliable and generalizable conclusions. By applying predetermined inclusion and exclusion criteria, an SLR minimizes selection bias and ensures that the conclusions drawn from the review are grounded in the highest-quality available evidence. The present study conducts a systematic review of peer-reviewed journal articles published between 2017 and 2026 that examine the effectiveness of the RME model in improving students' mathematical problem-solving abilities. The scope of this review encompasses a wide range of research designs, educational levels, and instructional contexts in order to provide a comprehensive picture of the current state of knowledge in this field.

The present study is guided by three research questions that together provide a comprehensive framework for analyzing the selected studies and synthesizing their findings in a structured and informative manner. The research questions are formulated as follows.

RQ1: At what level of education, study type, and context is the PMR model most effective in improving students' mathematical problem-solving abilities?

RQ2: What research methods and instructional designs are most commonly employed in studies investigating the effectiveness of RME on mathematical problem-solving?

RQ3: What are the identified gaps, limitations, and directions for future research in the existing literature on RME and mathematical problem-solving?

These three research questions collectively address the educational contexts in which RME is most effective, the methodological landscape of current research, and the future trajectory of the field. They are designed to ensure that the findings of this systematic review are both practically applicable for educators and theoretically meaningful for researchers working in the field of mathematics education.

METHOD

This study employed a Systematic Literature Review (SLR) methodology to systematically identify, screen, evaluate, and synthesize existing empirical studies on the effectiveness of Realistic Mathematics Education (RME) in improving students' mathematical problem-solving abilities. The SLR process was conducted following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, which provide a standardized framework for conducting and reporting systematic reviews. PRISMA is widely recognized as a gold standard for systematic review methodology, ensuring transparency, reproducibility, and rigor throughout the review process. The application of PRISMA guidelines in this study aimed to minimize the risk of bias and to ensure that the review findings accurately reflect the state of evidence in the field.

The literature search was conducted across two major academic databases: Scopus, an international multidisciplinary database indexing peer-reviewed journals, and SINTA (Science and Technology Index), Indonesia's national journal indexing system. These databases were selected because they collectively cover a broad range of high-quality mathematics education journals indexed at national and international levels. The search was performed using the following keywords and Boolean operators: "Realistic Mathematics Education" OR "RME" OR "PMRI" AND "mathematical problem-solving" OR "problem-solving ability" AND "mathematics education." The search was limited to articles published between 2017 and 2026 to ensure the currency and relevance of the evidence base.

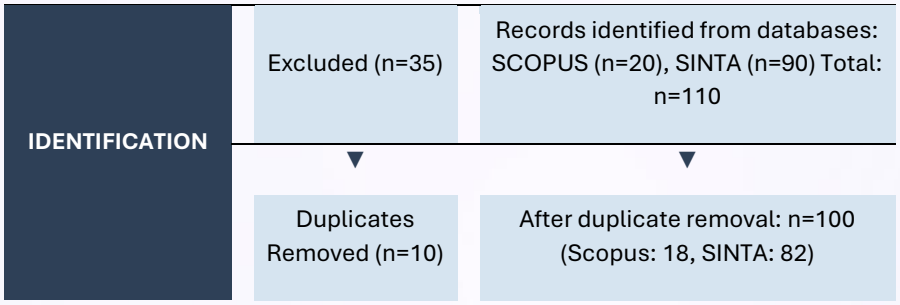
The study applied clearly defined inclusion and exclusion criteria to determine the eligibility of articles for inclusion in the review. The inclusion criteria required that articles: (1) were published in peer-reviewed journals indexed in Scopus or SINTA between 2017 and 2026; (2) focused specifically on the implementation of the RME or PMRI approach; (3) measured mathematical problem-solving as an outcome variable; (4) used quantitative, quasi-experimental, experimental, or Research and Development (R&D) research designs; and (5) involved junior high, or senior high school students as research subjects. Articles were excluded if they: (1) were conference papers, theses, or book chapters; (2) were not available

in full text; (3) focused on higher education or teacher education contexts only; or (4) did not include measurable empirical data related to mathematical problem-solving outcomes.

Table 1. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Articles published in 2017-2026	Articles published before 2017
Related to RME and mathematical problem-solving	Not directly related to RME or mathematical problem-solving
Published in accredited journals (Scopus, SINTA 1-4)	Conference proceedings, theses, and book chapters
Full-text articles available in Indonesian or English	Articles not available in full-text or not accessible
Used measurable methods (quantitative/R&D)	Articles without empirical data or measurement outcomes
Subjects are junior high, or high school students	Studies on university students or professional teachers only

The article selection process followed the four-phase PRISMA flow diagram as presented in Figure 1. In the identification phase, a total of 110 articles were retrieved from the databases: 20 from Scopus and 90 from SINTA. After removing 10 duplicate records, 100 unique articles remained for further screening. In the screening phase, the titles and abstracts of all 100 articles were evaluated against the inclusion and exclusion criteria, resulting in the exclusion of 45 articles that were deemed irrelevant based on their topic, research design, or subject population. The remaining 55 articles were retrieved in full text for detailed eligibility assessment. During the eligibility phase, an additional 30 articles were excluded for various reasons, including lack of direct focus on mathematical problem-solving, absence of empirical data, or failure to meet the methodological quality standards established for this review. Following this rigorous multi-phase selection process, a final corpus of 25 articles was included for data extraction and synthesis.



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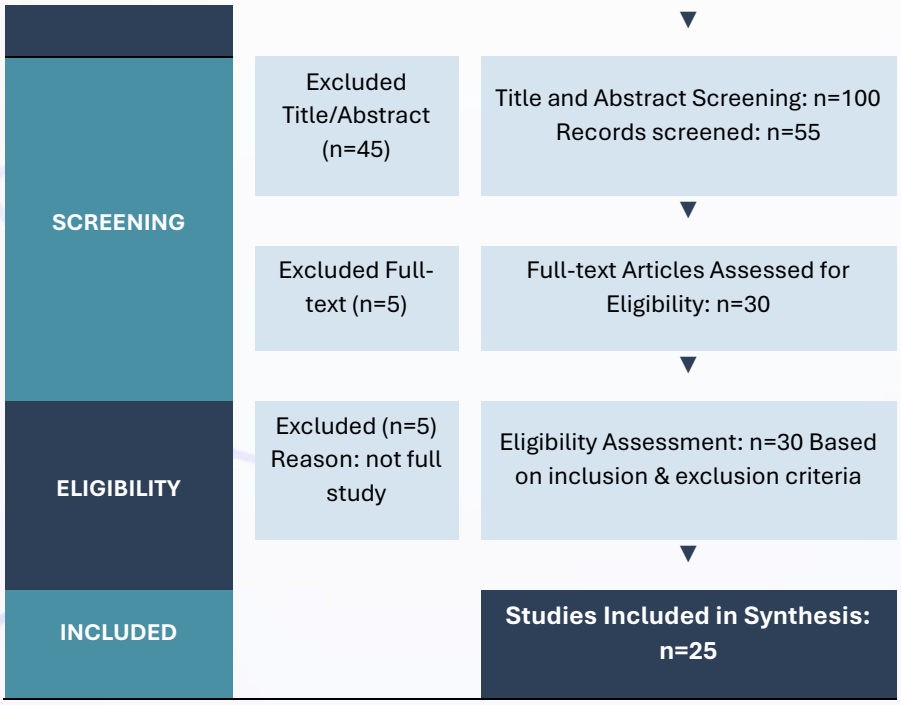

Figure 1. PRISMA Flowchart for Article Selection Process

Data extraction was performed using a structured coding framework that captured the following information from each article: (1) article identity including authors, year of publication, journal name, and indexing status; (2) research objectives and questions; (3) research design and methodology; (4) subject characteristics including educational level and sample size; (5) instruments and data collection methods; (6) statistical analyses employed; (7) key findings and conclusions; and (8) identified research gaps and limitations. This coding framework was developed based on established practices in educational systematic reviews and was piloted with five sample articles before being applied to the full corpus. The extracted data were subsequently organized into a summary matrix to facilitate cross-study comparison and thematic synthesis.

RESULT AND DISCUSSION

Overview of Selected Studies

The systematic review identified 25 peer-reviewed articles that met the inclusion criteria, published between 2017 and 2026 across journals indexed in Scopus and SINTA. In terms of indexing level, 2 articles (8%) were retrieved from Scopus-indexed journals, with one classified as Q3 and one as Q4, while the remaining 23 articles (92%) were from SINTA-indexed journals, ranging from SINTA 2 to SINTA 3. Among the SINTA-indexed articles, 15 were classified as SINTA 2 and 8 as SINTA 3, reflecting a concentration of studies in nationally recognized journals with moderate to high levels of quality. The distribution of

publication years shows a clear upward trend in research output over the review period, with the majority of articles published between 2021 and 2026, indicating growing scholarly interest in the application of RME for mathematics education reform in Indonesia.

The 25 selected studies were conducted across various educational levels, with the majority targeting junior high school students (Sekolah Menengah Pertama or SMP), which accounted for approximately 68% of the studies reviewed. Senior high school and vocational school students were the subjects in approximately 20% of the studies, while the remaining 12% involved both levels or did not specify the exact educational stage. Sample sizes varied considerably across the studies, ranging from as few as 13 students in action research designs to as many as 77 students in experimental studies with multiple classes. This variability in sample size reflects the diversity of research contexts and methodological approaches employed by the studies included in this review. Most studies were conducted in public schools located in various provinces of Indonesia, including West Java, Banten, North Sumatra, Riau, East Java, and East Nusa Tenggara.

In terms of research methodology, four major categories were identified among the 25 selected studies. Quasi-experimental studies constituted the largest group, comprising approximately 44% of the reviewed articles. Research and Development (R&D) studies represented approximately 40% of the total, with the majority employing either the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) or the 4D model (Define, Design, Develop, Disseminate) as their development framework. Classroom Action Research (CAR) or Penelitian Tindakan Kelas (PTK) accounted for approximately 8% of the studies, while true experimental designs were found in 8% of the articles. This methodological diversity reflects the multifaceted nature of research on RME implementation and indicates that the field employs a range of approaches to investigate both the development of RME-based instructional materials and their effectiveness in improving students' mathematical problem-solving outcomes.

Table 2. Summary of 25 Selected Studies on RME and Mathematical Problem-Solving

No.	Author (Year)	Journal / Index	Method	Subject	Key Findings
1	Hasim et al. (2025)	JPMI (SINTA 3)	Quasi-Experiment	60 SMP students	RME+VBA Excel sig. outperforms conventional; sig.(2-tailed)=0.000
2	Sutarni & Aryuana (2023)	Al-Ishlah (SINTA 2)	CAR (2 cycles)	13 SMP students	Problem understanding rose from 23% to 85%; all indicators exceeded target
3	Manggarrani & Marhaeni (2025)	EDUMATSAINS (SINTA 3)	Quasi-Experiment	72 SMA students	RME worksheet sig. more effective; mean gain: 28.05 vs 11.39
4	Refianti et al. (2026)	Edumatica (SINTA 2)	R&D ADDIE	28 SMP students	LKS valid (Aiken V=0.73), practical (80%), N-Gain=0.64 (moderate)

No.	Author (Year)	Journal / Index	Method	Subject	Key Findings
5	Heldawati et al. (2024)	Jurnal Tek. Pendidikan (SINTA 3)	R&D ADDIE	70 SMA students	E-module valid 88.3%; mastery increased from 24% to 87%
6	Tumangger et al. (2024)	IndoMath (SINTA 3)	R&D ADDIE	20 SMP students	85% students reached KKM; avg posttest 81.83; LKPD very practical
7	Nurfadilah et al. (2021)	Prima (SINTA 3)	True Experiment	24 SMP students	RME posttest 51.57 vs scientific 39.80; no interaction with prior ability
8	Ulandari et al. (2019)	IEJME (Scopus Q4)	R&D 4D	36 SMP students	Mastery improved from 69% to 89%; self-efficacy mostly good/very good
9	Purwadi (2020)	SEAMEJ (SINTA 2)	CAR (3 cycles)	19 SMP students	MPS average rose from 65.5 to 75.0; mastery from 47% to 89%
10	Ginting & Rakhmawati (2024)	Prisma Sains (SINTA 2)	True Experiment	42 SMP students	Experiment mean 84.76 vs control 60.90; sig.(2-tailed)=0.000
11	Sugiarti et al. (2025)	JagoMIPA (SINTA 3)	Quasi-Experiment	49 SMP students	RME mean 80.54 > conventional 72.09; math anxiety significantly reduced
12	Lestari et al. (2025)	JPMI (SINTA 3)	Quasi-Experiment	64 SMP students	N-Gain 0.75 (high); Mann-Whitney sig.=0.002; ICT enhanced visualization
13	Ahmad & Asmaidah (2017)	Mosharafa (SINTA 2)	R&D 4D	~50 SMP students	Device validity RPP=4.26; experiment mastery 91.67%; student response 95.83%
14	Sari et al. (2025)	MTRJ (Scopus Q3)	R&D Plomp	25 SMP students	Valid Aiken V=0.78-0.96; very practical; N-Gain=0.52; sig.(2-tailed)=0.000
15	Hidayat et al. (2026)	IJORER (SINTA 2)	Quasi-Experiment	40 SMP students	Problem-solving 78.90 vs 68.45; communication 81.25 vs 69.20; both sig.
16	Ningsi et al. (2024)	Mathema Journal (SINTA 3)	Quasi-Experiment	59 SMK students	RME+Flipped mean 80.17 vs conventional 59.31; p=0.000
17	Muhammad et al. (2025)	Jurnal Perspektif (SINTA 3)	R&D ADDIE	30 SMP students	Device valid (avg 3.4); 76% mastery; 100% high learning independence
18	Sukmaningthias et al. (2023)	Mosharafa (SINTA 2)	Quasi-Experiment	64 SMP students	Posttest: 87.42 vs 43.45; Pixton comic RME sig. effective (p=0.000)
19	Pertiwi et al. (2018)	JPMI (SINTA 3)	Experiment	77 SMP students	Spearman r=0.615 (strong) in RME+Geogebra class; positive significant relation
20	Lubis et al. (2020)	EDUMATIKA (SINTA 2)	Quasi-Experiment	60 SMA students	PMR N-Gain 0.45 > guided discovery 0.43; ANOVA sig.=0.001

No.	Author (Year)	Journal / Index	Method	Subject	Key Findings
21	Zulfah et al. (2025)	AKSIOMA (SINTA 2)	R&D Plomp+Gravemeijer	30 SMP students	LIT very valid (3.45-3.58); very practical (87.8%); MPS avg 80.96 (very effective)
22	Mulyowati et al. (2023)	Jurnal Pend. Progresif (SINTA 3)	R&D 4D	SMK students	Flipbook valid, very practical; paired t-test sig. $p<0.05$
23	Rakhmawati (2023)	EDUMATIKA (SINTA 2)	R&D ADDIE + Experiment	64 SMP students	Module valid (4.15-4.18); practical; t-obs=1.974 > t-crit=1.701; sig. effective
24	Zetriuslita et al. (2025)	JRPM (SINTA 2)	R&D + Quasi-Experiment	64 SMP students	Posttest 75.47 vs 51.69; t=6.08 > t-table; SWS valid (80.6%-82.83%)
25	Anggraini & Fauzan (2020)	EDUMATIKA (SINTA 2)	Quasi-Experiment	68 SMP students	RME overall sig. (p=0.002); especially effective for low self-efficacy students

RQ1: Educational Level, Study Type, and Context of PMR Effectiveness

The first research question examines at what educational level, type of study, and instructional context the PMR model proves most effective in improving students' mathematical problem-solving abilities. Analysis of the 25 selected studies reveals that RME implementation was most extensively and successfully applied at the junior high school level (SMP), with approximately 68% of the reviewed studies targeting Grade VII, VIII, or IX students. Within this educational level, the most consistent and statistically robust gains in problem-solving performance were observed in studies that employed structured contextual activities aligned with the four Polya stages: understanding the problem, devising a plan, carrying out the plan, and looking back. Studies at the senior high school (SMA) and vocational school (SMK) levels, while fewer in number, also demonstrated significant improvements, suggesting that the RME model adapts effectively to more advanced mathematical content and diverse institutional settings.

In terms of study type, Research and Development (R&D) studies at the SMP level that produced LKPD (Lembar Kerja Peserta Didik) or student worksheets based on RME principles consistently achieved high levels of validity, practicality, and effectiveness. Refianti et al. (2026) and Tumangger et al. (2024) both demonstrated that RME-based worksheets for Grade VII and VIII students yielded strong problem-solving outcomes, with mastery rates of 64% and 85% respectively. At the SMA level, Heldawati et al. (2024) developed an e-module using the PMR approach that resulted in learning mastery increasing from 24.29% to 87.14%, reflecting the high adaptability of RME materials across educational stages. Quasi-experimental studies involving direct comparison with conventional learning at the SMP level similarly showed significant advantages for RME, with effect sizes consistently favoring the RME group across provinces including West Java, Riau, Banten, and North Sumatra.

The instructional context in which RME proved most effective was one that integrated contextual problems drawn from students' everyday environments, whether through local cultural elements, technological tools, or student-centered collaborative learning structures. Studies that incorporated ethnomathematics, such as Ginting and Rakhmawati (2024) who used the traditional Engklek game as a context for geometry instruction, reported among the highest mean posttest scores in the entire corpus, with the experimental group achieving 84.76 compared to 60.90 in the control group. Similarly, studies that combined RME with digital technology, such as Lestari et al. (2025) using interactive ICT tools (N-Gain = 0.75) and Hasim et al. (2025) employing VBA Excel (sig. = 0.000), consistently outperformed pure conventional instruction. The combination of RME with culturally responsive or technology-enhanced contexts therefore represents the most powerful configuration for maximizing its impact on mathematical problem-solving.

Among the mathematical topics investigated, RME demonstrated particularly strong effectiveness in content areas with natural real-world connections, such as social arithmetic, statistics, linear equations, quadrilaterals, and geometry. These topics lend themselves readily to contextualization within RME's horizontal mathematization framework, allowing students to transition smoothly from informal reasoning about real-world situations to formal mathematical representation and problem-solving. Topics that are more abstract in nature, such as algebraic reasoning and transformational geometry, also yielded significant improvements under RME instruction, though the gains were somewhat more variable across studies. Overall, the evidence strongly supports the conclusion that RME is most effective at the junior high school level, within R&D and quasi-experimental study types, and in instructional contexts that are rich in culturally relevant, technologically supported, or student-centered contextual activities that meaningfully connect mathematics to students' lived experiences.

RQ2: Research Methods and Instructional Designs

The analysis of research methods across the 25 selected studies reveals a rich diversity of methodological approaches employed to investigate the effectiveness of RME in improving mathematical problem-solving. Quasi-experimental studies with pretest-posttest control group designs were the most prevalent, reflecting the field's preference for comparative designs that can establish causal relationships between RME instruction and problem-solving outcomes while accounting for pre-existing differences between groups. These studies typically employed independent sample t-tests, Mann-Whitney U tests, or Analysis of Variance (ANOVA) as their primary analytical tools, with several studies supplementing inferential statistics with N-Gain analysis to quantify the magnitude of improvement attributable to RME instruction. The consistency of statistically significant results across these diverse quasi-experimental studies lends strong support to the conclusion that RME produces genuine improvements in students' problem-solving abilities.

Research and Development studies represent the second major methodological cluster, with the majority employing either the ADDIE or 4D development model to create validated, practical, and effective RME-based instructional materials. These studies typically assessed the quality of their developed products across three dimensions: validity (as determined by expert validators using content and construct validity frameworks), practicality (as assessed through student and teacher response questionnaires), and effectiveness (as measured by pretest-posttest comparisons and mastery threshold analyses). Refianti et al. (2026) exemplify this approach, reporting Aiken's V coefficients of 0.69 to 0.73 for their PMRI-based student worksheets, practicality scores of 80%, and an N-Gain of 0.64. Zulfah et al. (2025), using a combined Plomp and Gravemeijer design framework, developed a Local Instructional Theory (LIT) for the topic of quadrilaterals that achieved very valid (mean validator scores of 3.45 to 3.58), very practical (87.8%), and very effective (mean MPS score of 80.96) ratings.

Several studies in the review examined the role of technology integration in enhancing the effectiveness of RME instruction. These studies incorporated a variety of digital tools and platforms, including VBA Excel, Geogebra, interactive whiteboard software, the Pixton comic application, and digital flipbooks developed using Flip PDF Corporate and AppGeyser. The integration of these technologies within an RME framework was found to enhance student engagement, facilitate visualization of abstract mathematical concepts, and support contextual problem-solving through interactive and multimedia-rich learning environments. Pertiwi et al. (2018) found a strong positive correlation (Spearman r = 0.615) between mathematical problem-solving ability and learning activeness in the RME with Geogebra class, compared to a moderate correlation (r = 0.346) in the conventional class, highlighting the added value of technology-enhanced RME for student engagement and learning outcomes.

Studies employing Classroom Action Research (CAR) methodology provided valuable insights into the iterative and reflective dimensions of RME implementation within authentic classroom settings. These studies followed the cyclical CAR framework of planning, action, observation, and reflection across multiple cycles, allowing teachers to systematically identify and address barriers to effective RME implementation in real time. The use of multiple data collection instruments in CAR studies, including observation sheets, field notes, documentation, and problem-solving tests, ensured that the findings captured both quantitative improvements in student performance and qualitative insights into the processes through which RME supports learning. The convergence of findings across these different methodological traditions strengthens the overall evidence base for RME's effectiveness and provides practical guidance for mathematics teachers seeking to implement RME in their classrooms.

RQ3: Research Gaps and Directions for Future Research

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Despite the compelling evidence for the effectiveness of RME in improving mathematical problem-solving, the systematic review identifies several consistent limitations and research gaps that warrant attention in future studies. The most frequently noted limitation across the reviewed articles is the restricted sample size and single-school research setting, which significantly constrain the generalizability of the findings. The majority of the 25 studies reviewed involved fewer than 70 students drawn from a single school or class, making it difficult to determine whether the positive effects of RME instruction would hold across more diverse student populations, school contexts, and geographic regions. Future research should prioritize multi-school and multi-regional designs with larger and more diverse samples to establish more robust and generalizable evidence for RME's effectiveness.

A second pervasive gap identified in the reviewed literature is the narrow topical scope of the studies, with most focusing on a single mathematical topic or unit within a relatively brief instructional period. Topics such as linear equations, quadrilaterals, triangles, arithmetic sequences, and statistics were the most commonly investigated content areas, leaving a broad range of mathematical domains underexplored. The brevity of most intervention periods, often spanning only a few weeks or a single semester, also limits the ability to assess the sustained long-term effects of RME instruction on students' mathematical problem-solving development. Longitudinal studies that track student progress over multiple academic years and across a variety of mathematical topics would provide valuable insights into the cumulative benefits of sustained RME implementation.

The absence of control groups in many R&D studies represents another significant methodological limitation of the current literature. While such studies provide detailed evidence of the validity, practicality, and effectiveness of RME-based instructional materials, the lack of comparison conditions makes it impossible to attribute observed improvements exclusively to the RME approach rather than to maturation effects, the novelty of new instructional materials, or other confounding variables. Future R&D studies should incorporate parallel control conditions to enable more rigorous causal inference regarding the specific contributions of RME design principles to student learning outcomes. Additionally, the limited attention given to affective variables such as students' mathematical anxiety, self-efficacy, learning motivation, and learning independence in most of the reviewed studies represents a gap that future research should address comprehensively.

Finally, the present review identifies a need for more research examining the implementation of RME in the context of the Kurikulum Merdeka, Indonesia's most recent curriculum framework introduced in 2022. Only a small number of the reviewed studies explicitly positioned their research within the Kurikulum Merdeka context, suggesting that the field has not yet fully explored the alignment between RME principles and the competency-based, student-centered philosophy of the new curriculum. Given that Kurikulum Merdeka places strong emphasis on project-based learning, differentiated instruction, and the cultivation of Pancasila student profiles, RME's contextual and student-centered design makes it a particularly promising approach for supporting curriculum implementation. Research that

systematically investigates how RME can be optimally integrated with Kurikulum Merdeka, including its Computational Thinking and Projek Penguatan Profil Pelajar Pancasila (P5) components, would make a significant contribution to both theory and practice in Indonesian mathematics education.

CONCLUSION

This systematic literature review synthesized evidence from 25 peer-reviewed studies published between 2017 and 2026 to examine the effectiveness of the Realistic Mathematics Education (RME) model in improving students' mathematical problem-solving abilities. Guided by three research questions, the review addressed the educational levels and contexts in which RME is most effective, the methodological landscape of current research, and the gaps that remain unaddressed in the existing literature. The review findings provide robust and consistent empirical support for the conclusion that RME implementation produces significant and meaningful improvements in students' mathematical problem-solving competencies across various educational levels, instructional contexts, and research designs. Whether applied through quasi-experimental designs, Research and Development frameworks, or Classroom Action Research cycles, and whether enhanced with contextual materials, digital technologies, or culturally responsive elements such as ethnomathematics, RME consistently outperforms conventional instructional approaches in fostering students' ability to understand problems, devise solution strategies, execute mathematical procedures, and critically evaluate their answers.

The mechanisms through which RME promotes problem-solving development include its use of real-world contextual problems as the starting point for mathematical learning, its emphasis on horizontal and vertical mathematization through student-guided inquiry and discovery, its facilitation of collaborative problem-solving and mathematical discourse, and its capacity to reduce students' mathematics anxiety while increasing engagement and intrinsic motivation. The integration of RME with technology tools such as Geogebra, interactive media applications, and digital modules further amplifies its effectiveness by providing dynamic visual representations and interactive learning environments that support the development of conceptual understanding alongside procedural fluency. These findings confirm that RME's theoretical principles, when faithfully implemented in instructional practice, translate into demonstrable learning gains that are both statistically significant and educationally meaningful.

Notwithstanding these positive findings, the review also identifies important limitations in the current research literature that constrain the strength of the conclusions that can be drawn. The predominance of small-scale, single-school studies with short intervention periods limits the generalizability and external validity of the evidence base. The relative neglect of affective variables, longitudinal outcomes, and comparison conditions in many R&D studies further constrains our understanding of the full scope of RME's effects on student learning and development. For future research, it is recommended that scholars design larger-scale

multi-school studies with adequate control conditions, extend intervention periods to capture cumulative learning effects, investigate a wider range of mathematical topics and grade levels, and explore the integration of RME with emerging pedagogical frameworks such as Computational Thinking and the Kurikulum Merdeka. These directions for future research will enrich the evidence base and enhance the practical applicability of RME for mathematics teachers, curriculum developers, and educational policymakers in Indonesia and beyond.

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REFERENCES

Ahmad, M., & Asmaidah, S. (2017). Pengembangan perangkat pembelajaran matematika realistik untuk membelajarkan kemampuan pemecahan masalah matematika siswa SMP. Jurnal Mosharafa, 6(3), 373-383.

Anggraini, R. S., & Fauzan, A. (2020). The effect of realistic mathematics education approach on mathematical problem solving ability. EDUMATIKA: Jurnal Riset Pendidikan Matematika, 3(2), 94-101.

Ginting, S. M. B., & Rakhmawati, F. (2024). The influence of realistic mathematics education (RME) model based on ethnomathematics of Engklek game on students' mathematical problem-solving abilities. Prisma Sains: Jurnal Pengkajian Ilmu dan Pembelajaran Matematika dan IPA IKIP Mataram, 12(3), 428-438.

Hasim, P., Sabandar, J., & Fitrianna, A. Y. (2025). Meningkatkan kemampuan pemecahan masalah matematis terhadap pendekatan RME berbantuan VBA Excel. JPMI: Jurnal Pembelajaran Matematika Inovatif, 8(1), 59-70.

Heldawati, H., Yulianti, D., Nurhanurawati, N., Nurwahidin, M., & Sutiarso, S. (2024). E-modules with Realistic Mathematics Education (PMR) approach to improve students' mathematical problem solving skills. Jurnal Teknologi Pendidikan, 9(4), 599-608.

Hidayat, A., Nurhaswinda, Yusrina, E., & McCauley, V. (2026). The influence of the RME learning model on mathematical problem solving and communication skills in mathematics learning in students of SMP 1 Bangkinang City. IJORER: International Journal of Recent Educational Research, 7(3), 1085-1097.

Lestari, A. P., Fitriani, N., & Bernard, M. (2025). Penerapan pendekatan Realistic Mathematics Education (RME) berbantuan teknologi interaktif untuk meningkatkan kemampuan pemecahan masalah matematis siswa kelas VIII. JPMI: Jurnal Pembelajaran Matematika Inovatif, 8(1), 81-90.

Lubis, W. A., Ariswoyo, S., & Syahputra, E. (2020). Kemampuan pemecahan masalah matematika melalui pendekatan pendidikan matematika realistik dan pendekatan

penemuan terbimbing berbantuan Autograph. EDUMATIKA: Jurnal Riset Pendidikan Matematika, 3(1), 1-12.

Manggarrani, A., & Marhaeni, N. H. (2025). The effectiveness of using RME-based students' worksheet to improve students' mathematical problem-solving skills. EDUMATSAINS, 9(2), 317-326.

Muhammad, M., Lubis, A., & Simanjorang, M. M. (2025). Development of mathematics learning tools based on Realistic Mathematics Education (RME) to improve students' mathematical reasoning and learning independence. Jurnal Perspektif, 9(1), 12-22.

Mulyowati, D., Fitriana, L., Triyanto, & Wiraya, A. (2023). Digital flipbook-based mathematics teaching materials using RME approach to improve mathematical problem-solving ability. Jurnal Pendidikan Progresif, 13(3), 1460-1468.

Ningsi, G. P., Nendi, F., Sugiarti, L., Jeramat, E., & Gahung, A. (2024). Realistic Mathematics Education (RME) kombinasi Flipped Classroom ditinjau dari kemampuan pemecahan masalah dan representasi matematis. Mathema Journal, 6(1), 152-163.

Nurfadilah, I., Nindiasari, H., & Fatah, A. (2021). Using Realistic Mathematics Education in mathematical problem-solving ability based on students' mathematical initial ability. Prima: Jurnal Pendidikan Matematika, 5(1), 35-46.

Pertiwi, C. M., Fitriani, T., & Afrilianto, M. (2018). Relasi antara kemampuan pemecahan masalah matematik dan keaktifan belajar matematik siswa SMP yang menggunakan pendekatan Realistic Mathematics Education berbantuan Geogebra. JPMI: Jurnal Pembelajaran Matematika Inovatif, 1(4), 513-524.

Purwadi, I. M. A. (2020). Improving VIII grade students' mathematical problem solving ability through Realistic Mathematics Education. Southeast Asia Mathematics Education Journal (SEAMEJ), 10(1), 13-26.

Rakhmawati, I. A. (2023). The social arithmetics module based on Islamic values and Realistic Mathematics Education to improve students' problem-solving skills. EDUMATIKA: Jurnal Riset Pendidikan Matematika, 6(1), 17-29.

Refianti, R., Luthfiana, M., & Adha, I. (2026). Development of Indonesian Realistic Mathematics Education-based student worksheets to measure students' mathematical problem-solving abilities. Edumatica: Jurnal Pendidikan Matematika, 16(1), 40-53.

Sari, D. N., Hasratuddin, & Fauzi, K. M. A. (2025). Development and validation of Realistic Mathematics Education-based worksheets for junior high school students. Mathematics Teaching Research Journal, 17(1), 99-127.

Sugiarti, L., Jeramat, E., Jelatu, S., & Harjo, Y. F. (2025). Pengaruh pendekatan pembelajaran Realistic Mathematics Education (RME) terhadap kemampuan pemecahan masalah matematika siswa ditinjau dari kecemasan matematis. JagoMIPA: Jurnal Proses Belajar Matematika dan IPA, 5(1), 215-225.

Sukmaningthias, N., Hasyanah, Y., Sari, N., & Nuraeni, Z. (2023). The influence of RME-based teaching media assisted by Pixton application on students' mathematics problem solving ability. Mosharafa: Jurnal Pendidikan Matematika, 12(2), 363-374.

Sutarni, S., & Aryuana, A. (2023). Realistic Mathematics Education (RME): Implementation of learning models for improving HOTS-oriented mathematics problem-solving ability. Al-Ishlah: Jurnal Pendidikan, 15(2), 1213-1223.

Tumangger, W. R., Khalil, I. A., & Prahmana, R. C. I. (2024). The impact of Realistic Mathematics Education-based student worksheet for improving students' mathematical problem-solving skills. IndoMath: Indonesia Mathematics Education, 7(2), 196-215.

Ulandari, L., Amry, Z., & Saragih, S. (2019). Development of learning materials based on Realistic Mathematics Education approach to improve students' mathematical problem solving ability and self-efficacy. International Electronic Journal of Mathematics Education (IEJME), 14(2), 375-383.

Zetriuslita, Andrian, D., Suripah, Maimunah, Hidayat, R., & Dacara, E. (2025). The effect of Realistic Mathematics Education approach to improve students' mathematics learning outcomes. Jurnal Riset Pendidikan Matematika, 12(1), 70-81.

Zulfah, E., Fauzan, A., & Arnawa, I. M. (2025). Pengembangan Local Instructional Theory topik segiempat berbasis RME untuk meningkatkan kemampuan pemecahan masalah matematis. AKSIOMA: Jurnal Program Studi Pendidikan Matematika, 14(2), 381-393.