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A SYSTEMATIC LITERATURE REVIEW ON LEARNING MEDIA AND REALISTIC MATHEMATICS EDUCATION (RME): CLASSIFICATION OF MEDIA TYPES AND RME CHARACTERISTICS IN ENHANCING MATHEMATICAL PROBLEM-SOLVING SKILLS

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Abstract
Mathematical problem-solving is a key competency in 21st-century education. Realistic Mathematics Education (RME) emphasizes real-world contexts and has been widely applied to support this skill, alongside the development of various instructional media. This study aims to systematically review the role of RME-based learning media in enhancing students' mathematical problem-solving skills. Using the PRISMA-guided SLR method, [e.g., 146] articles were identified from Google Scholar and Scopus. After duplicate removal and title–abstract screening, [e.g., 24] full-text articles were assessed, resulting in 12 studies included in the final synthesis. A Systematic Literature Review (SLR) was conducted following the PRISMA protocol. A total of [e.g., 146] articles were initially identified from Google Scholar and Scopus. After duplicate removal and title–abstract screening, [e.g., 24] full-text articles were assessed for eligibility, resulting in 12 studies included in the final synthesis. The analysis was organized into three main categories: (1) types of learning media (digital and non-digital), (2) key characteristics of RME (realistic context, progressive mathematization, and student-centered activities), and (3) impacts on students' mathematical problem-solving skills. The results indicate that both digital and non-digital RME-based media consistently improve students' problem-solving abilities.

Keywords: learning media, realistic mathematics education, problem-solving skills

1. Introduction

Problem-solving ability is one of the essential competencies in 21st-century mathematics education. In the learning context, students are not only required to understand mathematical concepts procedurally but also to apply them in complex and varied real life situations (Apriyanti et al., 2022; Indrawati et al., 2025). Therefore, contextual and meaningful learning approaches are important aspects to be developed and implemented (Palgunadi et al., 2021). Mathematics learning should not only emphasize procedural mastery but also focus on problem-solving skills that are relevant to real-life contexts. Various international studies indicate that meaningful and contextual learning approaches significantly contribute to improving students' mathematical problem-solving abilities (Chalkiadaki, 2018; Wu & Shen, 2020).

Advances in educational technology have further expanded opportunities for implementing Realistic Mathematics Education (RME) through the integration of both digital and non digital learning media. Several studies have shown that the use of RME-based learning media can enhance learning effectiveness and student motivation. For example, the development of RME-based animated videos has been proven to increase student engagement in understanding fraction concepts (Farhan & Sudatha, 2023; Dewantari, Agustika, & Ambara, 2025). The use of Android applications based on a realistic approach also contributes to improving critical thinking skills and mathematical problem-solving abilities (Indrawati et al., 2025; Ismayanty et al., 2023). In addition, media that integrate elements of local wisdom such as RME-based student worksheets incorporating local cultural values have been shown to strengthen learning relevance and enhance student motivation (Ladona, Caswita, & Ambrita, 2022; Saputri & Wahyuni, 2024).

Although numerous studies have been conducted, most focus on media development or the effectiveness of RME in specific contexts. However, existing reviews have not systematically examined the characteristics of RME-based learning media or synthesized how core RME principles are linked to mathematical problem-solving skills, leaving an important gap in the literature. Consequently, there is a lack of systematic studies that comprehensively compile and analyze these research findings. A comprehensive review is needed to map research trends, effectiveness, and the characteristics of RME-based media that most significantly contribute to improving problem-solving skills (Kadek et al., 2024; Narayani, 2019). Thus, this study is urgent in providing a scientific synthesis that can serve as a foundation for future innovations in RME-based mathematics learning.

In terms of novelty, this study differs from previous research by not limiting the review to a single type of learning media or a specific form of RME implementation. This study employs a Systematic Literature Review (SLR) approach to examine recent scientific publications (2020–2025), enabling a comprehensive identification of the characteristics, effectiveness, methodological trends, and development opportunities of RME-based learning media in supporting mathematical problem-solving skills. The SLR approach allows for the construction of a broader, deeper, and evidence-based research map that illustrates the relationship between types of media, RME principles, and problem-solving outcomes an academic contribution not yet offered by previous studies (Fitriana & Waswa, 2024; Miharja et al., 2024). Based on this rationale, the objective of this study is to systematically review the literature discussing the role of RME-based

learning media in improving students' mathematical problem-solving abilities. This review is expected to provide a comprehensive understanding of the effectiveness of RME-based learning media and to inform the direction of future innovations in developing more interactive, contextual, and adaptive learning media to meet students' learning needs in the digital era.

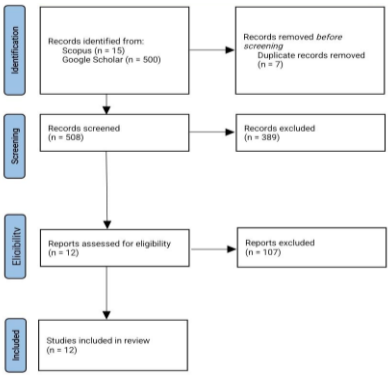
2. Methods

This study employed a Systematic Literature Review (SLR) approach to systematically identify, evaluate, and synthesize research findings related to the implementation of Realistic Mathematics Education (RME) in improving students' mathematical problem solving abilities. The SLR approach was selected because it provides a comprehensive, objective, and structured overview of research trends, media effectiveness, and opportunities for developing the RME approach across various learning contexts (Chalkiadaki, 2018). The SLR procedure in this study followed the PRISMA 2020 framework, which includes the processes of literature searching, application of inclusion and exclusion criteria, article screening, and the analysis and synthesis of findings.

The article screening process was conducted using predefined inclusion and exclusion criteria. The inclusion criteria comprised: (1) literature published in scientific journals between 2020 and 2025; (2) literature available in English or Indonesian; (3) studies targeting primary and secondary education levels; (4) empirical studies published in scientific journals employing classroom action research, experimental, or development research designs; (5) literature specifically related to mathematics education; and (6) studies explaining how RME-based learning media contribute to students' problem-solving abilities. The exclusion criteria included: (1) literature published before 2020; (2) literature not available in English or Indonesian; (3) studies targeting general populations, early childhood education, or higher education; (4) literature in the form of theses, dissertations, books, and systematic review articles; (5) studies related to general professional education fields such as medicine, health, socio-cultural studies, and engineering; and (6) studies that do not explain the role of RME-based learning media in students' problem-solving abilities.

The literature search was conducted using Publish or Perish (PoP) with the Google Scholar and Scopus databases. The literature search was conducted using the keywords ("media" OR "tools") AND "Realistic Mathematics Education" (RME) AND "problem solving", with Boolean operators applied to capture synonyms and variations. The search was limited to peer-reviewed journal articles published in English. A total of 515 articles were initially retrieved from Google Scholar and Scopus., which were then downloaded in RIS (Research Information System) format and imported into the Covidence application. Several steps were carried out in Covidence, including the identification and removal of duplicate records, title and abstract screening to identify relevant studies, and full-text screening of selected articles based on the established inclusion criteria.

Figure 1.
PRISMA Flow Diagram of the Study



Based on these stages, 12 articles were identified that specifically address RME-based learning media aimed at improving students' problem solving abilities. Subsequently, the 12 selected studies were analyzed according to the research questions of this study, namely: (1) how is the diversity of the selected literature distributed in terms of publication year, educational level, technology used, and research methods during the period 2020–2025?; (2) what is the role of RME-based learning media in students' mathematical problem-solving abilities during the period 2020–2025?; (3) what are the characteristics of RME-based learning media that can enhance students' problem-solving abilities during the period 2020–2025?; and (4) what limitations and development opportunities for RME-based learning media are identified in previous studies? The primary objective of this stage was to analyze and evaluate various research findings from the selected literature and to determine the most appropriate method for integrating explanations and interpretations of these findings (Cruzes & Dyba, 2011).

3. Result and Discussion

The 12 selected studies were analyzed and classified based on educational level, research method, and type of RME-based media (Table 1). The studies encompass a range of educational contexts, from elementary to vocational high school, and include both developmental and experimental or quasi-experimental designs. While the majority of studies focused on media development, several assessed the effectiveness of RME-based media on students' problem-solving skills.

Elementary School: Most studies targeting elementary students (A1, A3, A4, A5, A10) employed developmental approaches, creating student activity sheets, textbooks, and animation videos. These studies consistently reported improvements in students' problem-solving skills, particularly when the media incorporated realistic contexts and progressive mathematization. Experimental studies at this level were fewer but indicated that structured, interactive materials could produce measurable gains in problem-solving ability. Overall, conventional RME materials such as worksheets and textbooks remain predominant in elementary education.

Junior High School: Studies at the junior high level (A7, A8, A11, A12) leaned more toward digital and interactive media, including digital comics, audio-visual media, and Pixton-based applications. Quasi-experimental and experimental designs were frequently used to evaluate effectiveness. These studies showed moderate to high improvements in problem-solving skills, highlighting that digital media, when integrated with RME principles, are particularly effective for adolescents. Notably, media that facilitated student-centered, interactive engagement produced the highest reported gains.

Senior and Vocational High School: In upper secondary education (A2, A6, A9), RME-based media often utilized mobile applications, Android-based platforms, or digital flipbooks. These studies combined development with quasi-experimental designs to assess learning outcomes. Findings suggest that technology-assisted RME media can enhance not only problem-solving but also critical thinking and mathematical reasoning at higher educational levels.

Cross-Study Patterns: Across all educational levels, several patterns emerge:

1. Media Type and Effectiveness: Digital and interactive media are more prevalent and effective in secondary education, while conventional worksheets and textbooks dominate elementary settings.
2. Research Method and Measured Impact: Studies employing experimental or quasi-experimental methods consistently reported measurable improvements in problem-solving skills, whereas purely developmental or descriptive studies primarily focused on media design without assessing learning outcomes.
3. RME Principles: Regardless of media type, effective learning media consistently applied core RME principles: realistic contexts, progressive mathematization, and student-centered, interactive activities. These characteristics were strongly associated with reported gains in problem-solving ability.

In summary, the synthesis highlights that while RME-based media development is widespread, measurable effectiveness is most evident when interactive, technology-supported media are applied with rigorous experimental designs, particularly at the secondary education level. These findings provide a foundation for selecting and designing RME-based instructional media and for future research exploring their impact on mathematical problem-solving.

The results of this study consist of a summary and analysis of the 12 selected studies obtained through the research stages, which were then classified based on the details of he selected studies. Table 1 presents the details of the selected studies.

Table 1.
Details of Selected Studies

Code	Title	Year	Authors	Method	Educational Level	Technology
A1	Animation Videos Development Based on Realistic	2025	Dewantari, S. A.; Agustika, G. N. S.; Ambara, D. P.	Development	Elementary School	Canva and Camtasia

Code	Title	Year	Authors	Method	Educational Level	Technology
	Mathematics Education to Improve Grade III Students' Fraction Problem-Solving Skills					
A2	Development of Android-Based Media Using a Realistic Approach in Blended Learning to Improve Students' Problem-Solving and Mathematical Critical Thinking Skills	2023	Ismayanty, I.; Siregar, H.; Siagian, P.	Development	Senior High School	Android
A3	Development of Local Wisdom–Based Realistic Mathematics Education Student Activity Sheets on Students' Mathematical Problem-Solving Ability	2022	Ladona, E. E.; Caswita, C.; Ambrita, A.	Development	Elementary School	–
A4	Development of Student Activity Sheets Based on the Realistic Mathematics Education (RME) Approach for Elementary School Students	2023	Hidayati, A. N.; Sari, T. M.; Qiftiyah, M.	Development	Elementary School	–
A5	Development of Student Books Characterized by Indonesian Realistic Mathematics Education to Support	2022	Hastuti, I. D.; Ahyansyah; Mawaddah, S.; Sutarto	Development	Elementary School	–

Code	Title	Year	Authors	Method	Educational Level	Technology
	Mathematical Problem-Solving Ability					
A6	Digital Flipbook-Based Mathematics Teaching Materials Using the RME Approach to Improve Mathematical Problem-Solving Ability	2023	Mulyowati, D.; Fitriana, L.; Triyanto; Wiraya, A.	Development	Vocational High School	Flip PDF Corporate
A7	The Effect of RME-Based Digital Comics on Students' Mathematical Problem-Solving Ability	2023	Hasyanah, Y.; Sukmaningthias, N.; Sari, N.; Nuraeni, Z.	Quasi-Experimental	Junior High School	Digital Media
A8	The Effect of RME-Based Audio-Visual Media on the Mathematical Problem-Solving Ability of Grade VIII Students	2022	Silvia, M.; AB, J. S.; Partasiwi, N.	Experimental	Junior High School	Audio-Visual Media
A9	Development of Interactive RME-Based Mathematics Learning Media Assisted by iSpring Software to Improve Students' Mathematical Problem-Solving Ability	2023	Aritonang, R.; Syahputra, E.	Development	Senior High School	iSpring
A10	The Effectiveness of the Realistic Mathematics	2022	Umar, U. P. S.; Zakaria, Z.	Experimental	Elementary School	–

Code	Title	Year	Authors	Method	Educational Level	Technology
	Education (RME) Learning Method Based on Manipulative Media in Improving Elementary Students' Problem-Solving Ability					
A11	The Impact of RME-Based Student Worksheets on Improving Students' Mathematical Problem-Solving Skills	2024	Tumangger, W. R.; Khalil, I. A.; Prahmana, R. C.	Development	Junior High School	–
A12	The Influence of RME-Based Teaching Media Assisted by the Pixton Application on Students' Mathematical Problem-Solving Ability	2023	Sukmaningthias, N.; Hasyanah, Y.; Siagian, P.	Quasi-Experimental	Junior High School	Pixton

Table 1 summarizes the 12 selected studies in terms of research method, educational level, and the type of RME-based media used. Most studies (A1–A6, A9, A11) employed developmental methods, focusing on designing student activity sheets, textbooks, animation videos, flipbooks, or mobile applications, while four studies (A7, A8, A10, A12) applied experimental or quasi-experimental designs to evaluate media effectiveness. Regarding educational levels, the majority of studies were conducted at the elementary and junior high school levels, with fewer studies at senior and vocational high schools. At the elementary level, conventional media such as worksheets, student books, and animation videos predominated. In junior high school, interactive and digital media including digital comics, audio-visual materials, and Pixton-based applications, were widely used. Senior and vocational high school studies primarily utilized Android-based applications and digital flipbooks. This overview highlights that while the type of media varies across educational levels, all studies emphasize the integration of RME principles in media design.

How is the diversity of the selected literature based on publication year, educational level, tools used, and research methods during the period 2020–2025?

Based on the identification of the selected literature according to publication year, educational level, use of technology, and research methods within the period 2020–2025, the diversity of the literature is presented in the form of graphical diagrams to facilitate clearer presentation. Literature published between 2020 and 2025 is illustrated using a line chart in Figure 2.

Figure 2.

Literature Based on Year of Publication

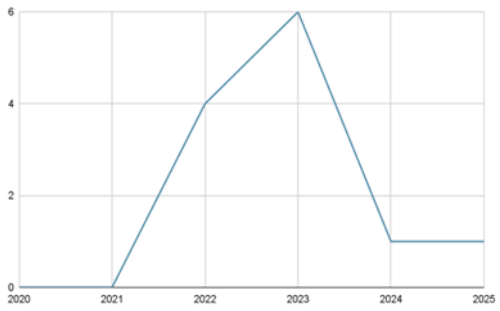
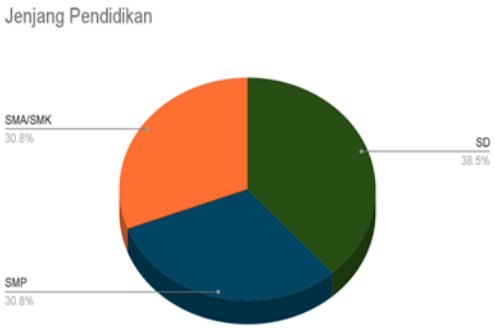


Figure 2 shows that the number of studies on mathematical problem-solving through RME-based learning media published during the period 2020–2025 tended to increase from 2020 to 2023, then decreased from 2023 to 2024, and remained stable from 2024 to 2025. Based on the selected studies, the distribution by educational level follows the inclusion criteria, ranging from elementary school to senior high school within the 2020–2025 period. The diversity of the literature based on educational level is presented in Figure 3.

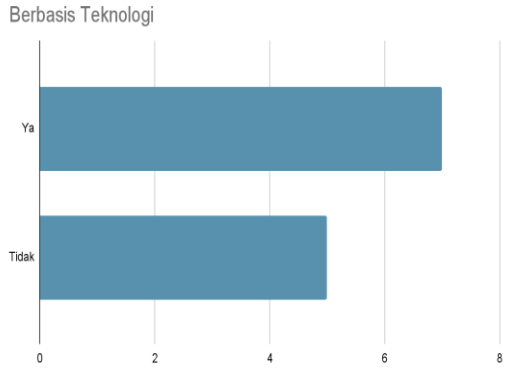
Figure 3.

Literature Based on Educational Level



In Figure 3, the elementary school level is represented in green, the junior high school level in blue, and the senior high school level in orange. The figure shows that research on mathematical problem-solving through RME-based learning media is predominantly conducted at the elementary school level, accounting for 38.5%, while studies at the junior high school and senior high school/vocational high school levels each account for 30.8%. Furthermore, the selected literature is reviewed based on the use of technology in RME-based learning media, as presented in Figure 4.

Figure 4.
Literature Based on Technology Basis



Based on the diagram above, it can be observed that seven studies employed technology-based learning media in the implementation of RME, while the remaining studies applied RME without the use of technology. Lastly, the selected literature is classified according to research methods. Figure 5 presents the distribution of research methods across the selected studies.

Figure 5.
Literature Based on Research Methods

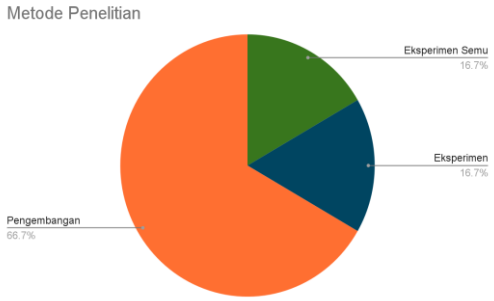


Figure 5 indicates that the development research method was the most frequently used, accounting for 56.7%, followed by experimental and quasi experimental methods, each representing 16.7%.

What is the role of Realistic Mathematics Education (RME)–based learning media in students' mathematical problem-solving abilities during the period 2020–2025? To understand students' problem-solving abilities through problem-based learning models supported by learning media, it is necessary to examine the research findings from the selected literature. Accordingly, a table summarizing the results of studies on the implementation of RME-based learning media and their effects on students' problem-solving abilities is presented below.

Table 4.
Research Findings from Selected Literature

Code	Findings
A1	This study shows that RME-based animated videos improve students' understanding of fraction topics by making abstract concepts easier to comprehend. This approach enhances problem-solving skills and student motivation, making it a valuable tool for teachers and curriculum developers. Future research may explore its impact on other mathematical topics and different grade levels.
A2	The findings from Trial I and Trial II indicate that the Android-based media developed using a realistic approach met the criteria of validity, practicality, and effectiveness. The application improved students' problem-solving and critical thinking skills. The N-gain value for problem-solving skills increased from 0.55 in Trial I to 0.60 in Trial II, indicating a moderate improvement. Similarly, the N-gain value for mathematical critical thinking skills increased from 0.63 to 0.67, also within the moderate category.
A3	The results indicate that the development of RME-based student worksheets integrated with local wisdom was deemed feasible based on expert validation and practical in terms of attractiveness, ease of use, and usefulness. The RME-based worksheets were effective in improving students' mathematical problem-solving abilities.
A4	The developed RME-based student worksheets were effective in improving problem-solving skills, as evidenced by differences in N-gain scores between pretest and posttest results. Students' average scores increased from 45.4 in the pretest to 77.8 in the posttest, with a normalized N-gain of 0.63 (moderate category), indicating effective learning outcomes.
A5	The findings show that the average validity percentage of the student book assessed by experts was 79.4%, categorized as valid or usable with revision. The average practicality percentage based on students' responses was 75.7%, categorized as practical. Meanwhile, the effectiveness percentage reached 77.5%, indicating that

Code	Findings
	the student book was effective in supporting students' mathematical problem-solving abilities.
A6	This study focused on students' mathematical problem-solving abilities in statistics content. The results indicate that the RME-based flipbook teaching materials were valid, practical, and effective in improving students' problem-solving abilities.
A7	The use of RME-based digital comics in mathematics learning helped train and enhance students' mathematical problem-solving skills, as evidenced by statistical results. Teachers are encouraged to use engaging and enjoyable instructional media to support learning objectives.
A8	The findings indicate that RME-based audio-visual media had a significant effect on the mathematical problem-solving abilities of Grade VIII students at UPT SMP Negeri 35 Bandar Lampung in the 2021/2022 academic year. The average problem-solving score of students using RME-based audio-visual media (80.96) was higher than that of students using conventional learning media (70.44).
A9	The development of interactive RME-based mathematics learning media assisted by iSpring software improved students' mathematical problem-solving abilities. Using a modified Luther development model, the study produced an Android-based smartphone application that can be downloaded and installed by students.
A10	The results indicate that before the implementation of the RME method using manipulative media, students' average problem-solving score was 35.00 with an 8% mastery level. After implementation, the average score increased to 84.20 with a 92% mastery level. The findings demonstrate that RME-based manipulative media are effective in improving elementary students' mathematical problem-solving abilities and show significant differences before and after implementation.
A11	This study demonstrates that the developed RME-based student worksheets significantly improved students' problem-solving abilities. The findings provide empirical evidence supporting the effectiveness of the RME approach in enhancing Indonesian students' mathematical problem-solving skills and offer a theoretical and practical framework for advancing mathematics education in Indonesia.
A12	The implementation of RME-based learning media assisted by the Pixton application was effective in training students' mathematical problem-solving abilities during the learning process. Teachers are encouraged to use enjoyable and engaging learning media to achieve predetermined learning objectives.

Table 4 presents the research findings of the selected studies regarding the effectiveness of RME-based media on students' mathematical problem-solving skills. Across all studies, media were found to be effective when incorporating core RME principles: realistic contexts, progressive

mathematization, and student-centered interactive activities. In elementary education (A1, A3–A5, A10), worksheets, student books, and animation videos improved students' understanding of mathematical concepts and problem-solving skills, with measured gains ranging from moderate to high. In junior high school (A7, A8, A11, A12), interactive media such as digital comics, audio-visual materials, and Pixton applications demonstrated significant improvements in problem-solving abilities, supported by experimental and quasi-experimental evidence. Senior and vocational high school studies (A2, A6, A9) indicated that Android-based applications and flipbook media enhanced both problem-solving and critical thinking skills. These findings reveal a pattern across educational levels, showing that digital and interactive media are particularly effective at secondary levels, whereas conventional RME materials remain suitable and effective at the elementary level.

Based on the analysis of the literature reviewed in this study, the researchers found that udents' problem-solving abilities can be enhanced through RME-based learning media. RME always begins with realistic contexts that are closely related to students' daily lives. The problems presented are not merely abstract exercises but situations that can be encountered in students' everyday experiences, thereby fostering connections between real-life experiences and mathematical concepts (Dewantari et al., 2024; Setiawi et al., 2021). Furthermore, recent developments indicate that RME can be integrated with digital media such as animated videos, digital comics, flipbooks, and interactive applications to increase students' interest and understanding (Hasyanah et al., 2023; Priwitasari & Sudiarta, 2022). The findings of this study are consistent with the results reported by Susilawati et al. (2025), who found that the implementation of Realistic Mathematics Education integrated with technology and gamification was able to improve students' mathematical problem-solving abilities as well as their learning motivation. This suggests that the RME approach demonstrates consistent effectiveness in both national and international contexts.

What are the characteristics of RME-based learning media that can enhance students' problem-solving abilities during the period 2020–2025?

Realistic Mathematics Education (RME) is a mathematics learning approach that emphasizes meaning and the connection between mathematical concepts and students' real-world experiences. This approach has several key characteristics that have been widely applied in the development of various learning media and instructional materials, as evidenced by numerous studies in recent years. RME always starts from realistic contexts that are close to students' lives. The problems presented are not limited to abstract mathematical tasks but involve situations commonly found in students' everyday experiences, enabling the construction of links between real-life experiences and mathematical concepts (Dewantari, 2024; Silvia et al., 2022; Hastuti et al., 2022).

Within the RME framework, students are encouraged to develop their own models through the process of mathematical modeling. They formulate problem-solving strategies based on their understanding of the problem situation, which are then refined progressively (Hidayati et al., 2023; Sukmaningthias et al., 2023). Learning in RME is interactive and collaborative, with students actively participating in group discussions to compare various problem-solving strategies. Such

discussions facilitate the exchange of ideas and constructive negotiation of mathematical meaning (Ismayanty et al., 2023; Umar & Zakaria, 2022).

Moreover, the RME approach encourages students to construct their own strategies and solutions through a constructivist process known as guided reinvention. In this process, teachers act as facilitators, while students serve as active participants in the learning process (Ladona et al., 2022; Tumangger et al., 2024). Abstraction is developed progressively, moving from an understanding of concrete situations toward formal mathematical concepts, a process referred to as progressive formalization (Mulyowati et al., 2023; Dewantari, 2024). In addition, RME is fully activity-based, emphasizing student exploration, reasoning, and problem-solving rather than one-way lecture-based instruction (Hidayati et al., 2023; Silvia et al., 2022).

In the Indonesian context, several studies also highlight the importance of integrating cultural values and local wisdom into realistic learning contexts to enhance students' engagement and understanding of mathematics (Ladona et al., 2022). Finally, recent developments demonstrate that RME can be effectively integrated with digital learning media such as animated videos, digital comics, flipbooks, and interactive applications to further enhance students' interest and comprehension (Hasyanah et al., 2023; Aritonang & Syahputra, 2023).

What are the limitations and development opportunities of RME-based learning media identified in previous studies?

The findings of this review reinforce the constructivist foundation of RME, particularly the role of guided reinvention in facilitating students' transition from contextual reasoning to formal mathematical abstraction. Across educational levels, effective RME-based media consistently applied core principles such as realistic contexts, progressive mathematization, and student-centered interactive activities, highlighting that the improvement in problem-solving skills is largely driven by the pedagogical design rather than the technological sophistication of the media. These results align with constructivist theory, which emphasizes that learners actively construct knowledge through meaningful engagement with tasks grounded in real-world situations.

Despite their effectiveness, most RME-based learning media developed in previous studies remain relatively simple, including printed student worksheets, textbooks, digital flipbooks, comics, and non-interactive animated videos (Pratiwi et al., 2025). Such media, while enhancing cognitive outcomes, exhibit limitations: restricted flexibility in adjusting problem difficulty, lower appeal for students accustomed to interactive digital technologies, and the absence of process data that could reveal students' problem-solving strategies. Consequently, these media support learning of concepts but do not fully facilitate in-depth exploration or sustained development of problem-solving strategies.

Another notable limitation is the lack of interactivity and automated feedback in most RME-based media (Paramita, 2024; Purnamayanti et al., 2023). Videos, audio-visual materials, and digital comics tend to be passive, offering one-way information delivery without opportunities for students to actively manipulate objects or engage in problem-solving cycles. Constructivist learning theory posits that active engagement and reflection are critical for deep learning; without

interactivity and feedback, students may focus solely on final answers without considering alternative strategies or reflecting on the reasoning process (Rangu et al., 2025).

These limitations highlight development opportunities for future RME-based learning media. Incorporating interactive features, adaptive problem difficulty, and automated feedback can enhance engagement, allow for personalized learning, and provide insights into students' problem-solving strategies. Furthermore, integrating digital technologies with RME principles can facilitate progressive mathematization, guiding students from informal, context-based reasoning toward formal mathematical abstractions, while reinforcing the process of guided reinvention. By addressing these gaps, future media can move beyond supporting only cognitive outcomes to enabling deeper, sustained, and more independent problem-solving skills..

These conditions present significant opportunities for developing more innovative RME-based learning media by integrating high levels of interactivity and automated feedback systems (Suharta & Astawa, 2024). For example, digital worksheets can be enhanced with interactive quizzes, simulations based on realistic contexts, and tiered feedback that not only indicates whether an answer is correct or incorrect but also provides specific hints and scaffolding tailored to students' needs (Suarsana et al., 2021 Despite the insights provided by this review, several limitations should be acknowledged. First, the number of included studies is relatively small (12 studies), which may limit the generalizability of the findings. Second, the studies are predominantly conducted in Indonesia, resulting in a regional concentration that may not reflect the broader international context of RME implementation. Third, the review may be subject to potential publication bias, as only peer-reviewed journal articles published in English and indexed in Google Scholar or Scopus were considered, possibly excluding relevant grey literature or studies in other languages.

4. Conclusion

Learning media based on Realistic Mathematics Education (RME) consistently play an effective role in improving students' mathematical problem-solving abilities across various levels of primary and secondary education. The RME approach has been proven to bridge students' understanding between abstract mathematical concepts and real-life situations encountered in their daily experiences, thereby making learning more meaningful and contextual. Numerous studies indicate that both digital media such as animated videos, digital comics, and Android applications and non digital media such as student worksheets and textbooks are equally effective in helping students develop critical and strategic thinking skills when solving mathematical problems.

Effective RME-based learning media possess several key characteristics, including the use of realistic contexts that are relevant to students' experiences, the application of progressive mathematization processes that guide students from concrete understanding to abstract reasoning, interactive and collaborative learning activities, and the implementation of constructivist principles that position students as active participants in the learning process. In addition, several studies highlight the importance of integrating cultural values and local wisdom into the development of RME-based learning media to enhance student engagement and learning motivation.

However, the review also reveals that most learning media developed in previous studies remain relatively simple and passive, such as non-interactive videos or comics, and have not fully

utilized the potential of digital technology to provide automated feedback and opportunities for independent exploration. These limitations point to significant opportunities for developing more innovative, interactive, and adaptive RME-based learning media. Such media are expected not only to improve learning outcomes but also to facilitate critical thinking processes, reflection, and the sustained development of students' mathematical problem solving abilities.

5. Aknowledgments

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6. References

Andrean, N. J., Noer, S. H., & Asmiati. (2019). Pengembangan pembelajaran penemuan terbimbing untuk meningkatkan kemampuan berpikir reflektif dan kemandirian belajar siswa. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika, 8*(2), 270–278.

Apriyanti, D. A. K., Suharta, I. G. P., & Astawa, I. W. P. (2022). Development of online learning device with a contextual approach to improve students' mathematics problem-solving ability. *International Journal of Engineering Technologies and Management Research, 9*(10), 61–72. https://doi.org/10.29121/ijetmr.v9.i10.2022.1184

Aritonang, R., & Syahputra, E. (2023). Pengembangan media pembelajaran matematika interaktif berbasis RME berbantuan software Ispring dalam meningkatkan kemampuan pemecahan masalah matematis siswa. *Prosiding Seminar Nasional Pendidikan Matematika 2023*, 484–492.

Chalkiadaki, A. (2018). A systematic literature review of 21st century skills and competencies in primary education. *International Journal of Instruction, 11*(3), 1–16. https://doi.org/10.12973/iji.2018.11301a

Cruzes, D. S., & Dyba, T. (2011). Research synthesis in software engineering: A tertiary study. *Information and Software Technology, 53*(5), 440–455. https://doi.org/10.1016/j.infsof.2011.01.004

Dewantari, S. A., Agustika, G. N. S., & Ambara, D. P. (2025). Animation videos development based on realistic mathematics education to improve III grade fraction problem-solving skills. *International Journal of Natural Science and Engineering, 8*(3).

Farhan, M., & Sudatha, I. G. W. (2023). Interactive learning multimedia based on Indonesian realistic mathematics education in mathematics subjects. *Jurnal Edutech Undiksha, 11*(2), 221–229. https://doi.org/10.23887/jeu.v11i2.63853

Fitriana, H., & Waswa, A. N. (2024). The influence of a realistic mathematics education approach on students' mathematical problem-solving ability. *Interval: Indonesian Journal of Mathematical Education, 2*(1), 29–35. https://doi.org/10.37251/ijome.v2i1.979

Hasyanah, Y., Sukmaningthias, N., Sari, N., & Nuraeni, Z. (2023). Pengaruh digital komik berbasis realistic mathematic education terhadap kemampuan pemecahan masalah. *Jurnal Tadris Matematika, 4*(1), 56–65. https://doi.org/10.47435/jtmt.v4i1.1750

Hastuti, I. D., Ahyansyah, A., Mawaddah, S., & Sutarto. (2022). Development of student books characterized by Indonesian realistic mathematics education to support mathematics problem-solving ability. *Jurnal Teori dan Aplikasi Matematika, 6*(1), 36–50. https://doi.org/10.31764/jtam.v6i1.5338

Hidayati, A. N., Sari, T. M., & Qiftiyah, M. (2023). Development of student activity sheets based on the realistic mathematics education (RME) approach for elementary school students. *Jurnal Al-Mudarris, 6*(1).

Indrawati, K. A. D., Ardana, I. M., & Sariyasa. (2025). Pengembangan e-modul berbasis model pembelajaran CORE untuk meningkatkan kemampuan pemecahan masalah. *Jurnal Pendidikan dan Pembelajaran Matematika Indonesia, 14*(1), 73–82.

Ismayanty, I., Siregar, H., & Siagian, P. (2023). Development of Android media based on a realistic approach in blended learning to improve students' problem solving and mathematical critical thinking skills. *Paradikma Jurnal Pendidikan Matematika, 17*(1), 56–62. https://doi.org/10.24114/paradikma.v17i1.56287

Kadek, N., Pradila, S., Agustika, G. N., & Wiyasa, I. K. N. (2024). Meningkatkan kompetensi pengetahuan matematika dengan model realistic mathematics education berbantuan media konkret. *Jurnal Media dan Teknologi Pendidikan, 4*(1), 61–68. https://doi.org/10.23887/jmt.v4i1.62890

Ladona, E. E., Caswita, C., & Ambrita, A. (2022). Development of local wisdom realistic mathematics education-based student activity sheet on students' mathematics problem-solving ability. *Jurnal Matematika dan Pendidikan Matematika, 6*(1), 1–12.

Miharja, M. A., Bulayi, M., Viet, L., & Triet, M. (2024). Realistic mathematics education: Unlocking problem-solving potential in students. *Interval: Indonesian Journal of Mathematical Education, 2*(1), 50–59. https://doi.org/10.37251/ijome.v2i1.1344

Mulyowati, D., Fitriana, L., Triyanto, T., & 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. https://doi.org/10.23960/jpp.v13.i3.202342

Narayani, N. P. U. D. (2019). Pengaruh pendekatan matematika realistik berbasis pemecahan masalah berbantuan media konkret terhadap hasil belajar matematika. *Jurnal Ilmiah Sekolah Dasar, 3*(2), 220–229.

Palgunadi, N. P. P. D., Sudiarta, I. G. P., & Ardana, I. M. (2021). Pengaruh model pembelajaran ALC berbasis e-modul terhadap kemampuan pemecahan masalah. *JIPM (Jurnal Ilmiah Pendidikan Matematika), 9*(2), 114–125. https://doi.org/10.25273/jipm.v9i2.8286

Paramita, P. Y. (2024). E-module containing ethnomathematics to improve mathematical problem-solving ability. *International Journal of Social Science, Management and Economics Research, 2*(5), 71–76.

Pratiwi, N. P. D. A., Ariawan, I. P. W., & Sariyasa. (2025). Pengaruh ilustrasi gambar pada soal geometri bidang terhadap kemampuan pemecahan masalah matematis siswa SMP. *Jurnal Pendidikan Matematika, 5*(2), 126–142.

Priwitasari, P., & Sudiarta, I. G. P. (2022). Pengaruh penerapan model problem-based learning berbantuan computer-based test terhadap kemampuan pemecahan masalah dan kemandirian belajar matematika. *JIPM (Jurnal Ilmiah Pendidikan Matematika), 10*(2), 206–218.

Purnamayanti, I. G. A., Suharta, I. G. P., & Astawa, I. W. P. (2023). Pengembangan e-LKPD interaktif berorientasi PMRI untuk meningkatkan kemampuan pemecahan masalah matematika siswa SMP kelas IX. *Jurnal Cendekia: Jurnal Pendidikan Matematika, 7*(3), 3147–3158.

Rangu, M. D., Astawa, I. W. P., & Suharta, I. G. P. (2025). Analysis of mathematical problem-solving skills SPLDV material based on story questions reviewed. *JKPI: Jurnal Konseling Pendidikan Islam, 6*(1), 315–325.

Setiawi, A. P., Suparta, I. N., & Suharta, I. G. P. (2021). The effect of the GeoGebra-assisted problem based learning model on problem solving ability and critical thinking ability. *Daya Matematis: Jurnal Inovasi Pendidikan Matematika, 9*(1), 42–47.

Silvia, M., AB, J. S., & Partasiwi, N. (2022). Pengaruh penggunaan media audio visual berbasis realistic mathematics education (RME) terhadap kemampuan pemecahan masalah matematika siswa kelas VIII semester genap.

Suarsana, I. M., Sudatha, I. G. W., Mahayukti, G. A., & Apsari, R. A. (2021). Mathematical word problem solving abilities of hearing-impaired students. *Journal of Physics: Conference Series, 1778*. https://doi.org/10.1088/1742-6596/1778/1/012006

Suharta, I. G. P., & Astawa, I. W. P. (2024). Thinking process of situation modeling in real life mathematical problem solving. *International Journal of Social Science, Management and Economics Research, 2*(5), 22–28.

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.

Susilawati, W., Sharov, S., Pasqa, M., & Malik, H. (2025). Integrating realistic mathematics education, artificial intelligence, and gamification to enhance students' learning motivation and problem-solving skills. *Journal on Mathematics Education, 16*(4), 1257–1282. https://doi.org/10.22342/jme.v16i4.pp1257-1282

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. *Indonesia Mathematics Education, 7*(2), 196–215.

Umar, U. P. S., & Zakaria, Z. (2022). The effectiveness of the realistic math education (RME) learning method based on manipulative media in improving the problem-solving abilities of elementary school students. *Jurnal Penelitian Hukum dan Pendidikan, 21*(1), 1369–1376.

Wu, H.-K., & Shen, F.-C. (2020). Exploring the effects of instructional approaches on students' mathematical problem-solving abilities. *International Journal of Science and Mathematics Education, 18*(5), 907–926. https://doi.org/10.1007/s10763-019-10019-3