The STEM Approach in Enhancing Mathematical Problem-Solving Abilities in Elementary School Students

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Abstract
This research aims to describe the application of the STEM (Science, Technology, Engineering, and Mathematics) approach to mathematics learning in elementary schools, specifically in improving students' problem-solving abilities. This leads to a lack of space for students to develop higher-order thinking skills. This research uses the Systematic Literature Review (SLR) method, which involves gathering, reviewing, and analyzing various relevant literature on the application of the STEM approach in mathematics learning. The literature search process was conducted thru international and national databases such as Google Scholar, ERIC, ScienceDirect, and Garuda, obtained from 20 journals or articles published between 2018 and 2025. The results of this study indicate that the STEM approach is proven effective in integrating various disciplines, making learning more contextual and meaningful for students. Thru this approach, students not only learn mathematical concepts theoretically but are also able to connect them to real-life situations around them. Thus, implementing the STEM approach in elementary school mathematics learning can be a potential strategy for developing higher-order thinking skills, particularly students' problem-solving abilities.
Keywords: *STEM, problem solving, mathematics learning, elementary school*

Abstrak
Penelitian ini bertujuan untuk mendeskripsikan penerapan pendekatan STEM (Science, Technology, Engineering, and Mathematics) pada pembelajaran matematika di sekolah dasar, khususnya dalam meningkatkan kemampuan pemecahan masalah peserta didik. Hal itu menyebabkan kurangnya ruang bagi peserta didik untuk mengembangkan keterampilan berpikir tingkat tinggi. Penelitian ini menggunakan metode *Systematic Literature Review* (SLR), yaitu dengan menghimpun, mengkaji, dan menganalisis berbagai literatur yang relevan mengenai penerapan pendekatan STEM pada pembelajaran matematika. Proses pencarian literatur dilakukan melalui basis data internasional maupun nasional seperti Google Scholar, Scopus, dan ERIC yang diperoleh dari 20 jurnal atau artikel tahun 2018-2025. Hasil penelitian ini menunjukkan bahwa, pendekatan STEM terbukti efektif dalam mengintegrasikan berbagai disiplin ilmu sehingga membuat pembelajaran menjadi lebih kontekstual dan bermakna bagi peserta didik. Melalui pendekatan ini, peserta didik tidak hanya belajar konsep matematika secara teoritis, tetapi juga mampu menghubungkannya dengan situasi nyata di sekitar mereka. Dengan demikian, penerapan pendekatan STEM dalam pembelajaran matematika di sekolah dasar dapat menjadi strategi yang potensial untuk mengembangkan keterampilan berpikir tingkat tinggi, khususnya kemampuan pemecahan masalah peserta didik.
Kata kunci: *STEM, pemecahan masalah, pembelajaran matematika, sekolah dasar*

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INTRODUCTION

Education is the main pillar in the formation of quality human resources, capable of facing the challenges of the 21st century characterized by technological advancements, science, and the complexities of global life. In this regard, every learner must possess the ability to think critically, creatively, and collaboratively, and solve problems (Rochmatillah, 2022). To remain relevant to the increasingly complex and dynamic real-world challenges, teaching methods must be transformed in the 21st century, especially in elementary education.

Elementary schools, as the foundation of formal education, play a crucial role in shaping the personality, way of thinking, and basic abilities of students. Mathematics is one of the fields that significantly contributes to the development of logical and systematic thinking. Mathematics learning can be integrated with other subjects. Mathematics is a field full of abstract concepts, according to Aprilia and Fitriana (2022). It also requires students to be able to solve various problems in mathematics questions, which are essentially related to everyday situations (Sagita et al., 2023). Mathematics learning can help students acquire problem-solving skills, which include the process of understanding the problem, making a solution plan, solving the problem, and interpreting the solution results. Therefore, this ability plays an important role in supporting 21st-century life skills, especially in facing various complex real-life situations that require critical thinking, creativity, and the ability to make precise decisions.

Problem-solving skills are an essential component that students must possess in elementary school mathematics learning. Problem-solving ability is defined by Siswanto and Meiliasari (2024) as an individual's capacity to perform analysis, reasoning, evaluation, and reflection using prior knowledge to address problems and achieve goals. Mathematics teaches students to follow certain steps in problem-solving, which helps them develop analytical and structured thinking (Munawaroh et al., 2024). According to Polya (2014), there are four steps in solving mathematical problems, namely: (1) Understanding the Problem, (2) Devising a Plan, (3) Carrying Out the Plan, and (4) Looking Back. Therefore, students are taught to apply mathematical knowledge in exploring various solutions to the problems they encounter, especially in the context of word problems related to everyday life (Ermawati & Zuliana, 2020).

The results of the Program for International Student Assessment (PISA, 2022) study show that only 25% of Indonesian students reached Level 2 in reading, far below the OECD average of 74%. This impacts their low ability to understand mathematical word problems that require analytical skills. Sari & Subekti's (2023) research also revealed that most students still struggle to fully understand information, draw accurate conclusions, and use reading to solve problems. This condition is exacerbated by students' tendency to only memorize formulas and example problems without being able to relate them to real-world contexts (Sibarani et al., 2024). Thus, there is an urgency to present learning strategies that not only emphasize cognitive aspects but also develop high-level cross-disciplinary thinking skills relevant to the needs of the 21st century.

The low quality of mathematics learning is still dominated by conventional teaching methods, still emphasizes practice problems, and uses the lecture method (Sopiah, 2021). As a result, participation is low, leading students to become passive and mathematics learning becomes less meaningful (Akase, 2021). One of these is solving word problems, where students must know and be skilled in using the concepts, formulas, and theories they have learned (Sallira & Pattimukay, 2024). Additionally, there is a time constraint in learning mathematical concepts, which makes it difficult for students to connect mathematical learning with real-world situations (Safirah & Abdillah, 2024). In fact, problem-solving skills are one of the key abilities

needed to face life in the 21st century. It is under these conditions that the need for a learning strategy is indicated, one that not only enhances students' cognitive abilities in mathematics but also develops high-level thinking skills that are interdisciplinary. To address these challenges, an integrative and contextual learning approach is needed, one that can bridge the gap between classroom learning and the needs of the real world. One rapidly growing and globally recognized approach is the STEM approach.

The STEM approach, which stands for Science, Technology, Engineering, and Mathematics, encompasses four disciplines that are integrated into education to enhance students' problem-solving skills and critical thinking, as well as to make lessons more relevant to the real world (Brown et al., 2011). The STEM method in mathematics education encourages students to actively participate in an investigative and collaborative learning process. This method allows students to connect theoretical concepts with real-world situations, particularly by using information technology to solve problems. Therefore, STEM-based learning not only enhances mastery of academic subjects but also serves as an important pillar in the formation of an innovative, capable, and globally competitive generation. Through this approach, students are encouraged to actively engage in an investigative and collaborative learning process, thereby fostering deeper critical thinking and problem-solving skills. The application of the STEM approach in mathematics learning allows students to connect theoretical concepts with various real-life situations, particularly through the use of information technology in solving everyday problems (Widana & Septiari, 2021). STEM education in developed countries like the United States plays a strategic role in economic advancement and national security. It is crucial for the country's global competitiveness, based on the close relationship between the advancement of science and technology and long-term economic growth (Xie et al., 2015). Thus, STEM-based learning not only enhances mastery of academic subjects but also serves as an important foundation in shaping a generation that is competent, innovative, and ready to compete on a global scale.

In the context of elementary school mathematics education, the STEM approach can be integrated with problem-based learning, which involves activities that solve authentic problems relevant to real life. The results of the study by Gusmana and Syamzaimar (2025) show an increase in scores from 58.4 to 82.7 (an increase of 41.6%), while the control class only increased by 14.1% in elementary school mathematics problem-solving skills. The t-test also showed a significant difference ($p < 0.05$), indicating that the effectiveness of STEM is higher compared to conventional methods.

Thus, learning becomes more meaningful when students are actively involved in researching real problems and are encouraged to think critically and find solutions on their own. Because the STEM approach integrates design thinking, collaborative learning, and critical thinking skills, which are very important in the global era, this approach plays a crucial role in bridging the demands of 21st-century competencies with learning practices in elementary schools. In addition to supporting the improvement of academic learning outcomes, this method prepares students to become innovative and adaptive lifelong learners. The results of this study are reinforced by additional research by Martaningsih et al. (2022), which shows that STEM modules help students in problem-solving.

Based on these various findings, it can be concluded that the application of the STEM approach in mathematics learning has great potential to enhance students' problem-solving abilities. This ability is not just an academic skill, but rather a part of the essential 21st-century competencies that are greatly needed in facing a world that is constantly evolving, complex, and full of uncertainties. In real life, one must be able to formulate problems, analyze situations from various perspectives, and generate creative and applicable solutions. Therefore, learning designed with the STEM

approach not only supports the achievement of curriculum goals but also instills a scientific, collaborative, and innovative mindset from an early age. Therefore, the implementation of the STEM approach, particularly in the context of elementary schools in Indonesia, becomes very important to carry out. Thus, the STEM approach can become a strategic foundation in supporting the transformation of elementary education towards learning that is more relevant, adaptive, and aligned with the future needs of students.

METHODS

This research uses the Systematic Literature Review (SLR) approach. SLR is a structured method for collecting, deeply evaluating, integrating, and synthesizing findings from various relevant studies to answer specific research questions or topics (Norlita et al., 2023). The SLR technique focuses on identifying and analyzing relevant scientific literature, as well as producing a systematic review that can enhance the effectiveness and efficiency of knowledge management methodically (Akmal et al., 2023). In its implementation, this research begins with the search for articles related to the topic of discussion, namely the use of the STEM approach in improving problem-solving skills in elementary school mathematics learning. The purpose of this approach is to identify, evaluate, and synthesize various relevant previous research findings to obtain a comprehensive understanding of the topic being studied.

The SLR approach was chosen because it can provide a strong theoretical and empirical foundation through a systematic and structured literature review process. The selection of the SLR method is based on its ability to provide a strong theoretical and empirical foundation through a systematic and structured literature review. The data in this study consists of 20 systematic journals or articles published between 2018 and 2025, focusing on empirical studies that discuss the application of the STEM approach and its impact on the problem-solving abilities of elementary school students. Data sources were obtained from various online scientific databases such as Google Scholar, ERIC, ScienceDirect, and Garuda, selected based on ease of access, topic relevance, and scientific feasibility. The search process was conducted using keywords in Indonesian and English, including: "STEM approach," "problem-solving," "elementary mathematics," "STEM approach," "problem-solving," and "elementary mathematics." The data analysis technique used was content analysis, which involved classifying and synthesizing findings from various studies thematically based on research focus, the STEM approach used, and its impact on problem-solving abilities.

RESULT

Based on the review of relevant scientific articles published between 2018–2025, several key findings were obtained that can be classified into three main themes: (1) the effectiveness of the STEM approach on problem-solving abilities, (2) the forms of STEM approach implementation in mathematics learning, and (3) the challenges and strategies for implementing the STEM approach in elementary schools.

1. **The Effectiveness of the STEM Approach in Enhancing Problem-Solving Skills**

   Most studies conclude that the STEM approach significantly contributes to the improvement of problem-solving skills among elementary school students. Here are some examples from several studies found, including:

   First, research by Utami et al. (2018), shows that positive responses from students and teachers are indicators of the successful implementation of the STEM approach in mathematics learning. The module was able to foster students' curiosity and motivation to learn, as well as encourage their active involvement in various stages of thinking, from identifying problems, designing solutions, evaluating results, to reflecting on the learning process. In addition, this module

successfully integrates mathematical concepts practically in real-life contexts, thereby helping students develop the ability to solve problems concretely and meaningfully.

Second, another study by Martaningsih et al. (2022) reinforces these findings by showing that STEM-based mathematics learning modules significantly enhance critical thinking skills and problem-solving abilities. This module is designed thematically by integrating elements of mathematics, science, and technology through exploratory activities that enable students to actively participate in finding solutions to contextual and authentic problems.

Third, research by Widana and Septiari (2021) shows that STEM learning helps students relate mathematical concepts to real phenomena in their environment. They noted that the STEM approach fosters students' ability to use data, identify patterns, and develop problem-solving strategies in a more logical and structured manner. In their study, there was an improvement in the ability to interpret data and make mathematical generalizations after the implementation of STEM-based learning.

Fourth, research by Rasyid et al. (2023) on the application of the STEM approach through project-based learning models has proven effective in improving problem-solving skills among elementary school students. Based on the research results, there was a significant increase after students participated in learning with this approach, where they became more capable of understanding problems, designing solutions, and evaluating results independently and systematically. Project-based learning developed in the context of STEM encourages students to be active, creative, and directly involved in solving real problems, thereby directly contributing to the enhancement of higher-order thinking skills.

Fifth, as stated in the research by Siswanto and Meiliasari (2024), problem-solving skills are not only formed by cognitive abilities alone but also require habituation to facing challenges continuously. The STEM approach provides an appropriate learning environment to familiarize students with realistically facing problematic situations, as well as fostering perseverance, creativity, and self-confidence in solving complex mathematical tasks.

Table 1. Effectiveness of the STEM Approach in Improving Problem-Solving Skills

No.	Researcher	Impact on Problem-Solving Ability
1.	Utami et al. (2018)	Students are more active in identifying problems and evaluating solutions.
2.	Martaningsih et al. (2022)	Students can find solutions to contextual problems.
3.	Widana & Septiari (2021)	Students are more logical in reading data and making mathematical generalizations.
4.	Rasyid et al. (2023)	Students are more independent in designing, completing, and reflecting on solutions.
5.	Siswanto & Meiliasari (2024)	The formation of perseverance, creativity, and self-confidence in students.

Thus, it can be concluded that the effectiveness of the STEM approach in enhancing problem-solving skills lies in its ability to connect mathematics learning with the real world, activate student engagement in complex thinking processes, and foster a logical, reflective, and creative mindset from an early age.

2. Forms of Implementing the STEM Approach in Mathematics Learning

The implementation of the STEM approach in mathematics education at the elementary school level has been carried out through various learning models, teaching strategies, and innovative media designed to strengthen the integration of disciplines. The application of STEM in mathematics learning not only aims to enhance mastery of the material but also encourages students to develop critical thinking skills, problem-solving abilities, and decision-making based on real-world contexts.

a. STEM-Based Problem-Based Learning (PBL)

The STEM-based Problem-Based Learning (PBL) approach positions elementary school students as active problem solvers in real-world situations, making mathematics learning more meaningful and relevant. One international study by Martaningsih et al. (2022) mentions that Problem-Based Learning (PBL) integrated with STEM can improve the mathematical problem-solving abilities of elementary school children, which were previously considered weak.

Meanwhile, Hadi (2021) emphasized that the implementation of the PBL model integrated with the STEM approach is capable of creating a challenging learning environment and encourages students to think more deeply about mathematical problems. In this context, students are not only given tasks to solve problems but are also trained to understand situations, formulate problems, seek logical solutions, and reflect on the results. This approach has proven to make students more active, critical, and independent in the learning process, compared to conventional learning methods or PBL without STEM integration.

Thus, the STEM-based PBL approach not only deepens the understanding of mathematical concepts but also develops high-level thinking skills that are essential for students in the 21st-century learning era, such as critical, creative, and reflective thinking. This approach has become one of the promising strategies for creating adaptive, contextual, and meaningful mathematics learning at the elementary school level.

b. Project-Based Learning (PjBL) in the Context of STEM

The Project-Based Learning (PjBL) model integrated with the STEM approach provides contextual and meaningful learning experiences for elementary school students. Through problem-based projects, students are trained to integrate mathematical concepts with other disciplines such as science, technology, and engineering. This approach not only enhances conceptual understanding but also encourages critical, collaborative, and creative thinking skills.

Research by Utama, Saragih, and Handayani (2024) shows that the implementation of PjBL integrated with STEM in mathematics learning significantly enhances students' mathematical thinking skills. In the study, students were involved in a project to create a model of the school garden, where they had to calculate the perimeter and area using appropriate units. The results show that there is an improvement in learning completeness. These findings affirm that contextual project-based mathematics learning can enhance the quality of students' learning outcomes.

Next, Antika et al., (2024) presented the results of applying STEM-PjBL in mathematics subjects at elementary schools. Through the project of creating visual aids such as fraction boards and world temperature maps, students can understand mathematical concepts more deeply and practically.

Thus, the STEM-integrated Project-Based Learning approach is capable of creating a more vibrant, applicable, and real-life-relevant mathematics learning experience for elementary school students. Such learning not only

improves academic outcomes but also shapes students' character to be creative, collaborative, and capable of critically solving problems—important competencies in facing the challenges of the 21st century.

c. Integrated STEM Module

The development of STEM-based learning modules has become an important strategy in integrating mathematics, science, technology, and engineering into a single integrated learning theme. Utami, Jatmiko, and Suherman (2018) developed a mathematics module with a STEM approach for elementary school students. This module not only helps students understand mathematical concepts more concretely and contextually but also trains critical thinking, problem-solving, and creativity skills through enjoyable and meaningful project-based activities.

This module makes it easier for teachers to design contextual and interactive thematic learning. Activities such as designing, recording observation results, calculating data, and presenting the results in front of the class encourage students to understand mathematical concepts more deeply, while also building essential 21st-century skills such as critical thinking, problem-solving, collaboration, and creativity.

d. Utilization of Technology and Simulation

The utilization of media and digital technology has become an important component in supporting the STEM approach in mathematics learning at the elementary school level. Not only using computer-based software, some studies show that learning media in the context of STEM can also be simple teaching aids designed by themselves, which combine elements of science, technology, engineering, and mathematics.

One example is implemented by Welli Meinarni (2022), who applied the STEM learning model at SD Negeri Tanamodindi. Mathematics learning does not only take place in the classroom, but also outdoors with a contextual approach. Students are actively involved in projects to create homemade measuring tools such as wooden rulers, simple scales, and water measuring devices, which are used to solve mathematical problems in real situations like measuring the length of a bench, calculating water volume, or comparing the weight of objects. The learning media were directly developed by the students using easily found recycled materials, thereby encouraging creativity and engineering skills.

This approach not only strengthens the understanding of mathematical concepts such as measurement and comparison but also instills critical and collaborative thinking skills. The use of homemade tools allows students to experience the processes of design, testing, and direct evaluation, so they learn how mathematics is applied in the real world. In addition, this activity also involves affective aspects such as responsibility, cooperation, and confidence in presenting solutions.

Thus, the use of media in STEM mathematics learning does not always rely on advanced digital technology, but can instead involve simple tools designed and developed by the learners themselves. This creates a contextual, active learning experience and empowers students as real-life problem solvers.

Table 2. Forms of STEM Approach Implementation in Mathematics Learning in Elementary Schools

Implementation Strategy	Researcher	Research Findings
Problem Based Learning (PBL)	Martaningsih et al. (2022);	STEM-based PBL enhances problem-solving skills by training

Based on STEM	Hadi (2021)	students to think critically, understand real-life situations, design solutions, and reflect.
Project Based Learning (PjBL) Based on STEM	Utama et al. (2024); Antika et al. (2024)	STEM-based PjBL enhances problem-solving skills by training students to think critically, understand real situations, design solutions, and reflect.
Integrated STEM Module	Utami et al. (2018)	STEM modules support interactive and meaningful thematic learning through project activities, observations, data calculations, and presentations.
Utilization of Technology and Simulation	Meinarni (2022)	The use of simple tools made by students (rulers, scales, water measuring devices) enhances engineering skills, collaboration, and understanding of mathematical concepts.

The implementation of the STEM approach in mathematics learning at the elementary school level is carried out through various models such as Problem-Based Learning (PBL), Project-Based Learning (PjBL), integrated learning modules, as well as the use of technology and simple teaching aids. All of these strategies have proven capable of increasing active student engagement, strengthening conceptual understanding, and developing critical, creative, collaborative, and reflective thinking skills in solving mathematical problems contextually. This approach not only enriches the learning process but also makes mathematics more meaningful and relevant to the students' real lives.

3. Challenges and Implementation Strategies

Although the STEM approach has proven effective in enhancing the problem-solving abilities of elementary school students, its implementation still faces various challenges. The study results indicate several key obstacles that must be addressed for STEM-based learning to proceed optimally and sustainably.

One of the main challenges is the limited competence of teachers in integrating cross-disciplinary knowledge and designing project-based learning. Teachers still tend to apply a conventional approach that separates subjects. According to Haryati, Suryani, and Lestari (2020), many teachers do not yet have a comprehensive understanding of the principles and implementation of STEM-based learning, thus requiring continuous training and mentoring. This limited understanding impacts the low creativity in designing integrative and contextual learning activities.

Another challenge, based on the research by Abd Jalil et al., (2024) explains that the main challenge identified in this article is the low ability of Indigenous students to solve problem-based mathematics questions compared to simple numerical questions. This is caused by various factors, such as limitations in understanding the medium of instruction, misconceptions about mathematical concepts, reading difficulties, and a minimal connection between teaching materials and the cultural context of the students. This problem is exacerbated by the remote geographical location of the Orang Asli schools, the lack of supporting facilities, and the insufficient training for teachers in culturally sensitive teaching methods.

Limited learning time also becomes a significant obstacle. The implementation of project-based or problem-solving learning requires a considerable amount of time, while the time allocation in the curriculum is often insufficient. Meinarni (2022) found that teachers find it difficult to schedule lessons when implementing the STEM approach, especially when they have to integrate several subjects into one learning project. As a result, STEM activities are only partially implemented and not comprehensively, thus not providing maximum impact.

Based on the research conducted by Diputra and Tristiantari (2024), in elementary school mathematics education, there are several challenges in implementing the STEM approach, including the dominance of textbook-centered teaching methods, low mathematical literacy skills among students, and minimal training for students in using systematic problem-solving steps. Most students are only able to solve low-level math problems (PISA level 1) and are not yet able to respond to contextual problems with implied information or those requiring complex reasoning. Additionally, the lack of learning media relevant to real life and the limitations in the use of technology pose further obstacles in building meaningful mathematical understanding. Moreover, elementary school teachers generally still work individually and are not accustomed to planning lessons together, resulting in learning that tends to be sectoral (Haryati et al., 2020).

To address these challenges, several implementation strategies have been proposed in previous research. The first strategy is to develop a STEM-based learning design using the Project-Based Learning (PjBL) approach, which includes six stages of learning: orientation, strategy planning, application, communication, reflection, and assessment, and has proven effective in enhancing students' mathematical literacy and problem-solving skills (Diputra & Tristiantari, 2024). Additionally, ethnomathematics can be used to relate mathematical concepts to everyday life, as well as the development of contextual and culturally-based assessments for students that are integrated into STEM learning (Abd Jalil, 2024). In addition, the utilization of local resources and simple technology in the STEM approach will be more meaningful if linked to real problems in the students' surrounding environment, such as environmental issues, local culture, or community needs. Thus, although the challenges in implementing the STEM approach are still quite significant, the strategies that have been developed can assist teachers and schools in conducting integrative, meaningful, and relevant learning to the needs of the 21st century.

Table 3. Challenges and Solution Strategies

Researcher	Challenges of STEM Approach	Solution Strategies
Haryati et al. (2020)	The limitations of teachers' competencies in integrating cross-disciplinary learning.	Continuous training and mentoring for teachers in STEM learning design.
Abd Jalil et al. (2024)	The low ability of students to solve contextual problem-based questions.	The use of an ethnomathematics-based approach and contextual assessment that aligns with local culture.
Meinarni (2022)	Learning time is limited for the project-based STEM approach.	Flexible and integrative time planning in thematic curriculum.
Diputra dan Tristiantari (2024); Haryati et al.	The dominance of conventional methods and the low mathematical literacy of students.	The implementation of the STEM-based PjBL approach with 6 stages of learning and systematic training for teachers

(2020)	and students.

The use of the STEM approach in mathematics education at the elementary school level faces various challenges, such as limited teacher competence, low mathematical literacy among students, limited learning time, and a lack of contextual media and approaches. However, several strategies have been proposed to address these challenges, including teacher training, integration of ethnomathematics, development of project-based learning, and utilization of local resources. With the implementation of the right strategies, the STEM approach has the potential to create more contextual, meaningful, and relevant learning for the needs of the 21st century.

CONCLUSION

The STEM approach has proven effective in enhancing the problem-solving abilities of elementary school students. Various studies show that this approach can foster curiosity, motivation, and active engagement of students in critical and reflective thinking processes. STEM-based learning encourages students to relate mathematical concepts to real-world contexts, use data logically, and develop structured problem-solving strategies. In addition, the integration of science, technology, and thematic projects in learning allows students to develop creativity, independence, and higher-order thinking skills. The learning environment offered by this approach also habituates students to face challenges realistically, thereby fostering perseverance and self-confidence in solving complex problems.

The implementation of the STEM approach in mathematics education at the elementary school level is carried out through various innovative strategies that support the integration of disciplines and the strengthening of 21st-century skills. The STEM-based Problem-Based Learning (PBL) model positions students as active problem solvers in real contexts, thereby enhancing their critical, independent, and reflective thinking skills. Meanwhile, Project-Based Learning (PjBL) provides meaningful learning experiences through contextual projects that combine mathematics with science, technology, and engineering, and encourages creativity and collaboration. The use of integrated STEM modules facilitates interactive and applicative thematic learning and helps students understand mathematical concepts more deeply through exploratory activities. Additionally, the use of technology and simple teaching aids designed by students makes learning more contextual, practical, and relevant to everyday life. The overall implementation of this approach shows that the STEM approach is capable of creating more vibrant, adaptive mathematics learning and empowering students as future problem solvers.

Although the STEM approach has proven effective in enhancing problem-solving skills, its implementation in elementary schools still faces various challenges. The main constraints include the limited competence of teachers in designing interdisciplinary learning, low mathematical literacy among students, limited learning time, and minimal support in terms of relevant facilities and media. Challenges also arise from certain socio-cultural contexts, such as language barriers and limited access to education in remote communities. To address this, the proposed solution strategies include the development of project-based learning (PjBL) designs, continuous teacher training, the utilization of ethnomathematics, and the integration of local resources and simple technology in learning activities. With the implementation of adaptive and contextual strategies, STEM learning can take place more optimally, meaningfully, and in line with the needs of 21st-century learners.

The implication is that implementing the STEM approach in mathematics learning in elementary schools can be a strategic foundation for preparing a generation that is critical, creative, and ready to face global challenges. Further research

recommendations include the need to develop a more contextual STEM learning model that aligns with the characteristics of elementary school students, accompanied by continuous policy support and teacher training.

DAFTAR PUSTAKA

Abd Jalil, A. H., Abdullah, A. H., & Fakhrudidin, W. F. W. W. (2024, October). STEM Education and Mathematics Performance Among Orang Asli Primary School Students in Johor, Malaysia: Challenges and Recommendations. In *2024 IEEE Frontiers in Education Conference (FIE)* (pp. 1-9). IEEE.

Akase, F. (2021). Peningkatan Aktivitas Dan Hasil Belajar Siswa Pada Pembelajaran Matematika Realistik Di Kelas V SDN 8 Suwawa. *Aksara: Jurnal Ilmu Pendidikan Nonformal*, *7*(3), 1223-1230.

Akmal, A. N., Maelasari, N., & Lusiana, L. (2025). Pemahaman Deep Learning dalam Pendidikan: Analisis Literatur melalui Metode Systematic Literature Review (SLR). JIIP-Jurnal Ilmiah Ilmu Pendidikan, 8(3), 3229-3236.

Antika, H. N., Rusmana, E. E., Salsabila, A., & Kohar, A. W. (2024). Development of STEM-PjBL Learning Media to Improve Students' Critical Thinking Skills for Counting Whole Number and Fraction. INOMATIKA, 6(2), 120-141.

Aprilia, A., & Fitriana, D. N. (2022). Mindset awal siswa terhadap pembelajaran matematika yang sulit dan menakutkan. Journal Elmentary Education, 1(2), 28-40.

Brown, R., Brown, J., Reardon, K., & Merrill, C. (2011). Understanding STEM: current perceptions. Technology and Engineering Teacher, 70(6), 5.

Diputra, K. S., & Tristiantari, N. K. D. (2024). STEM (SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS) IN IMPROVING PRIMARY SCHOOL STUDENTS'MATHEMATICS LITERACY. *Dinamika Penelitian: Media Komunikasi Penelitian Sosial Keagamaan*, *24*(01), 19-34.

Ermawati, D., & Zuliana, E. (2020). Implementation of open-ended problems on mathematical problem-solving skill of elementary school students. *JPsd (Jurnal Pendidikan Sekolah Dasar)*, *6*(2), 145-157.

Gusmana, I., & Syamzaimar, S. Strategi Pembelajaran Berbasis STEM Untuk Meningkatkan Kemampuan Pemecahan Masalah Matematika SD/MI. *Juring (Journal for Research in Mathematics Learning)*, *8*(2), 153-164.

Hadi, F. R. (2021). Efektifitas Model Pbl Terintegrasi STEM Terhadap Kemampuan Berpikir Kritis Matematis Siswa Kelas V SD. Jurnal Pendidikan Tambusai, 5(3), 6644-6649.

Martaningsih, S. T., Maryani, I., Prasetya, D. S., Purwanti, S., Sayekti, I. C., Aziz, N. A. A., & Siwayanan, P. (2022). STEM problem-based learning module: A solution to overcome elementary students' poor problem-solving skills. Pegem Journal of Education and Instruction, 12(4), 340-348.

Meinarni, W. (2022). Implementasi Model Pembelajaran STEM Dalam Pembelajaran Matematika di SD. *JEMARI (Jurnal Edukasi Madrasah Ibtidaiyah)*, *4*(2), 109-114.

Munawaroh, Q., Wulandari, M. D., & Astuti, H. T. M. (2024). Improving Elementary School Students' Mathematics Problem Solving Skills through Problem-Based Learning (PBL) Based on Higher Order Thinking Skills (HOTS). *JENIUS (Journal of Education Policy and Elementary Education Issues)*, *5*(1), 1-11.

Norlita, D., Nageta, P. W., Faradhila, S. A., Aryanti, M. P., & Fakhriyah, F. (2023). Systematic literature review (SLR): pendidikan karakter di sekolah dasar. JISPENDIORA Jurnal Ilmu Sosial Pendidikan Dan Humaniora, 2(1), 209-219.

Polya, G. (2014). How to solve it: A new aspect of mathematical method. In *How to solve it*. Princeton university press.

Rasyid, A., Rinto, R., & Susanti, M. (2023). Project-based learning through the STEM approach in elementary schools: How to improve problem-solving ability. *Journal of Education For Sustainable Innovation*, *1*(1), 1-8.

Rochmatillah, F. (2022). Do There Any Higher Order Thinking Skills in the Cambridge Primary Mathematics Textbook?. Indonesian Journal of Curriculum and Educational Technology Studies, 10(1), 57-66.

Safirah, A. D., & Abdillah, M. I. (2024). Pengaruh model problem based learning terhadap kemampuan pemecahan masalah matematika siswa sd. ARSEN: Jurnal Penelitian Pendidikan, 1(2), 102-109.

Sagita, D. K., Ermawati, D., & Riswari, L. A. (2023). Kemampuan pemecahan masalah matematis siswa sekolah dasar. Jurnal Educatio Fkip Unma, 9(2), 431-439.

Sallira, H., & Pattimukay, N. (2024). Analisis Kemampuan Berpikir Kreatif Siswa dalam Menyelesaikan Masalah Keliling dan Luas Persegi Panjang Di Kelas III SD Negeri 68 Ambon. *PEDAGOGIKA: Jurnal Pedagogik Dan Dinamika Pendidikan*, *12*(1), 175-181.

Sari, P. D. R., & Subekti, E. E. (2023). ANALISIS KESULITAN SISWA DALAM MENYELESAIKAN SOAL PEMECAHAN MASALAH MATEMATIKA MATERI OPERASI HITUNG PECAHAN DI KELAS V SD NEGERI KAUMAN BLORA. Jurnal Wawasan Pendidikan, 3(1), 227-237.

Sibarani, S., Rusmini, R., Mendrofa, R. N., & Hasratuddin, H. (2024). Pengaruh Model Problem Based Learning (PBL) berbantuan Video Pembelajaran terhadap Kemampuan Pemecahan Masalah Matematis. Ideguru: Jurnal Karya Ilmiah Guru, 9(2), 479-486.

Siswanto, E., & Meiliasari, M. (2024). Kemampuan pemecahan masalah pada pembelajaran matematika: systematic literature review. Jurnal Riset Pembelajaran Matematika Sekolah, 8(1), 45-59.

Sopiah, S. (2021). Upaya Meningkatkan Kualitas Pembelajaran Matematika Materi Geometri dengan Menggunakan Pembelajaran Kooperatif Tipe STAD di MIN Kota Jambi. *Jurnal Basicedu*, *5*(3), 1377-1389.

Utama, C., Ulya, M. Y. N. U., Miranda, V. J. Y., Oktavella, V. R. D., Jannah, T. R. I., & Larasati, F. (2024). IMPLEMENTASI PROJECT BASED LEARNING UNTUK MENINGKATKAN KEMAMPUAN BERPIKIR MATEMATIS SISWA SEKOLAH DASAR PADA MATERI BANGUN DATAR TER-INTEGRASI STEM. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, *9*(3), 386-398.

Utami, T. N., Jatmiko, A., & Suherman, S. (2018). Pengembangan modul matematika dengan pendekatan science, technology, engineering, and mathematics (STEM) pada materi segiempat. Desimal: Jurnal Matematika, 1(2), 165-172.

Widana, I. W., & Septiari, K. L. (2021). Kemampuan berpikir kreatif dan hasil belajar matematika siswa menggunakan model pembelajaran Project-Based Learning berbasis pendekatan STEM. Jurnal Elemen, 7(1), 209-220.

Xie, Y., Fang, M., & Shauman, K. (2015). STEM education. *Annual review of sociology*, *41*(1), 331-357.