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Problem-Based Learning to Improve Elementary School Students' Understanding of Mathematical Concepts

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ABSTRACT: *Mathematics learning in elementary schools still faces low student conceptual understanding due to the dominance of lecture and teacher-centred learning methods. Students tend to memorise formulas without understanding the application of concepts in everyday life. This study aims to analyse the implementation and effectiveness of the Problem-Based Learning (PBL) model in improving elementary school students' mathematical conceptual understanding and identify supporting factors and obstacles to its implementation. This study adopted a qualitative case study design at SDN 2 Sendang, Ponorogo. Data collection involved participatory observation, structured interviews, and documentation. Primary data sources included the principal, teachers, and fifth-grade students, while secondary data sources included learning modules, evaluation results, documentation, and school archives. The researchers applied the Miles and Huberman model to analyse the data through data reduction, data presentation, and conclusion drawing, while source and technique triangulation ensured data validity. The results showed that the implementation of PBL through six main steps, namely orienting students to the problem, organising students for learning, guiding investigation, developing and presenting the work, evaluating problem-solving, and reflecting and applying, was able to increase active involvement, critical thinking skills, and students' understanding of mathematical concepts. Students become more active in discussions, ask questions, and are able to connect mathematical concepts to real-world situations. The implementation of PBL also has an impact on improving learning outcomes, as seen in the increase in average student report card grades from "inadequate" to "good." This study concludes that PBL is effective in improving elementary school students' understanding of mathematical concepts. However, the study is still limited to one school with a limited number of subjects.*

Pembelajaran matematika di sekolah dasar masih menghadapi rendahnya pemahaman konseptual siswa karena dominasi metode pembelajaran ceramah dan berpusat pada guru. Siswa cenderung menghafal rumus tanpa memahami penerapan konsep dalam kehidupan sehari-hari. Studi ini bertujuan untuk menganalisis implementasi dan efektivitas model Pembelajaran Berbasis Masalah (PBL) dalam meningkatkan pemahaman konseptual matematika siswa sekolah dasar dan mengidentifikasi faktor pendukung dan hambatan dalam implementasinya. Studi ini menggunakan

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desain studi kasus kualitatif di SDN 2 Sendang, Ponorogo. Pengumpulan data melibatkan observasi partisipatif, wawancara terstruktur, dan dokumentasi. Sumber data primer meliputi kepala sekolah, guru, dan siswa kelas lima, sedangkan sumber data sekunder meliputi modul pembelajaran, hasil evaluasi, dokumentasi, dan arsip sekolah. Peneliti menerapkan model Miles dan Huberman untuk menganalisis data melalui reduksi data, penyajian data, dan penarikan kesimpulan, sementara triangulasi sumber dan teknik memastikan validitas data. Hasil penelitian menunjukkan bahwa implementasi PBL melalui enam langkah utama, yaitu mengarahkan siswa pada masalah, mengorganisasi siswa untuk belajar, membimbing investigasi, mengembangkan dan mempresentasikan karya, mengevaluasi pemecahan masalah, serta merefleksikan dan menerapkan, mampu meningkatkan keterlibatan aktif, kemampuan berpikir kritis, dan pemahaman siswa terhadap konsep matematika. Siswa menjadi lebih aktif dalam diskusi, mengajukan pertanyaan, dan mampu menghubungkan konsep matematika dengan situasi dunia nyata. Implementasi PBL juga berdampak pada peningkatan hasil belajar, seperti yang terlihat pada peningkatan nilai rapor rata-rata siswa dari "tidak memadai" menjadi "baik". Studi ini menyimpulkan bahwa PBL efektif dalam meningkatkan pemahaman siswa sekolah dasar terhadap konsep matematika. Namun, penelitian ini masih terbatas pada satu sekolah dengan jumlah mata pelajaran yang terbatas.

Keywords: *Problem-Based Learning (PBL); Mathematics Learning; Mathematical Concepts; Elementary School; Contextual Learning.*

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I. INTRODUCTION

Elementary education plays a strategic role in developing students' thinking, problem-solving, and numeracy skills from an early age. Globally, elementary school students' mathematical abilities remain a major concern in various countries due to their low conceptual understanding of mathematics (Yabashiru et al., 2025). The Programme for International Student Assessment (PISA) results indicate that most students still struggle to connect mathematical concepts to real-life situations (Sa'diyah et al., 2024). This situation indicates that mathematics learning has not fully developed higher-order thinking skills and meaningful understanding in students. This problem also occurs at various levels of elementary education in Indonesia, where elementary mathematics learning still faces challenges in terms of students' conceptual understanding (Santi et al., 2021). Initial observations also revealed that many students tend to memorise formulas without understanding their actual applications, thus experiencing difficulties when faced with problems that differ from the examples taught. The reliance on teacher-centred teaching methods exacerbates this situation by limiting students' active involvement in learning. Previous research has shown that the dominance of lecture methods in mathematics learning results in students' inability to develop critical thinking and independent problem-solving skills (Guerrero et al., 2025). As a result, learning becomes less meaningful, and students struggle to deeply understand mathematical concepts (Amir et al., 2024). Therefore, a learning approach that connects abstract mathematical concepts with students' contextual experiences is needed to make learning more relevant and understandable.

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Empirically, this condition is evident in students' low ability to solve problem-based and contextual problems. Many students are only able to memorise formulas and solve problems, but struggle when presented with problems that require mathematical reasoning. Previous research has shown that elementary school students' poor understanding of mathematical concepts is influenced by a lack of exploratory activities and a lack of learning that connects the material to students' real lives (Kholid et al., 2021; Sella et al., 2024). This indicates a gap between mathematics learning objectives and classroom learning practices. Furthermore, challenges in mathematics learning are also influenced by low student engagement in the learning process. One-way learning tends to make students passive, often receiving information from the teacher without the opportunity to explore ideas independently. Previous research has revealed that less interactive learning leads to decreased student motivation to learn mathematics and results in poor learning outcomes (Rahayu et al., 2024). Therefore, a learning approach is needed that can create an active, collaborative, and experience-based learning environment so that students can develop a deeper understanding of concepts.

One approach considered effective in addressing this problem is Problem-Based Learning (PBL). The PBL model places real-world problems as the starting point for learning, encouraging students to think critically, conduct investigations, and find solutions both independently and collaboratively. According to constructivist theory, knowledge is constructed through an active process of individuals interacting with their environment (Piaget, 2003). In the context of mathematics learning, PBL enables students to construct concepts based on contextual learning experiences, thus enhancing meaningful understanding. In addition to constructivist theory. The PBL approach is also supported by social constructivism theory, which emphasises the importance of social interaction in the learning process. The theory also explains that learning will occur optimally when students engage in collaborative activities and receive support from their social environment. In problem-based learning, students are encouraged to discuss, exchange ideas, and work together to solve problems, thereby developing mathematical thinking skills more effectively (Vygotsky, 1978). Thus, PBL not only improves conceptual understanding but also develops students' social and communication skills.

Conceptually, PBL is a learning approach oriented toward solving authentic problems through a scientific investigation process. According to Arends (2014), PBL has the main characteristics of using real-life problems, student-centred learning, independent inquiry, and group collaboration. In elementary school mathematics learning, the use of contextual problems can help students understand the relationship between mathematical concepts and everyday life. This is important because elementary school-aged students are still in the concrete operational stage and therefore require real-world experiences to understand abstract mathematical concepts (Piaget, 2003). The contextual approach in PBL allows students to learn through situations close to their environment. The concept of contextual learning emphasises that knowledge is more easily understood when linked to students' real-life experiences (Johnson, 2002). In mathematics learning, the application of everyday life contexts can help students grasp the meaning of concepts in a more concrete and applicable way. Therefore, integrating PBL with a contextual approach is considered relevant for improving elementary school students' understanding of mathematical concepts.

Several previous studies have shown that PBL has a positive influence on students' mathematics learning outcomes. Research by Sari et al. (2026) found that the

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implementation of PBL significantly improved elementary school students' critical thinking skills and understanding of mathematical concepts. Other research also shows that PBL can improve students' mathematical problem-solving abilities compared to conventional learning (Wijayanti et al., 2025). These findings demonstrate that PBL has significant potential for improving the quality of mathematics learning.

However, most previous research has focused on improving learning outcomes or students' critical thinking skills in general (Aprilita & Handican, 2023; Ibrahim et al., 2020). Research specifically examining PBL as a contextual approach to improving elementary school students' mathematical conceptual understanding is still relatively limited. Furthermore, previous research generally only emphasises the application of learning models without deeply connecting them to students' real-life contexts in the elementary school environment. Thus, there is still a gap that needs to be addressed to understand how context-based PBL can improve students' conceptual understanding more comprehensively. Furthermore, this study places students' real-life experiences as a crucial part of the mathematics learning process. Thus, this study provides a new perspective on integrating problem-based learning with the everyday contexts of elementary school students. The novelty of this research is its focus on strengthening elementary school students' conceptual understanding of mathematics. This research also emphasises the use of authentic problems close to students' lives, making learning more relevant, active, and meaningful. Furthermore, this study examines the learning process holistically, from student engagement and thinking processes to the ability to deeply understand mathematical concepts. The uniqueness of this research is also evident in the effort to integrate mathematics learning with students' social and environmental experiences in elementary school. Thus, this research is expected to create learning that is not solely oriented toward academic outcomes but also focuses on developing students' critical thinking, collaborative thinking, and problem-solving skills. Thus, mathematics learning is no longer viewed as abstract material but as part of students' daily lives.

This research was conducted at SDN 2 Sendang Ponorogo for several reasons, one of which is the school's strong commitment to improving the quality of learning. Based on observations and initial interviews with educators, fifth-grade students still experience difficulty understanding mathematical concepts, especially in material that requires deeper thinking. This situation presents both a challenge and an opportunity to implement a problem-based learning model, with teachers as the primary support. Furthermore, the school provided a positive response and full support for the implementation of this research, enabling the researchers to maximise their efforts in collecting valid data as needed.

This research is important because understanding mathematical concepts is the main foundation for learning mathematics at the next level. Students with a good conceptual understanding will more easily develop logical, analytical, and systematic thinking skills. Conversely, poor conceptual understanding can lead to ongoing difficulties in learning mathematics (Rafiq et al., 2023). Therefore, learning innovations are needed to improve the quality of students' understanding of mathematical concepts starting from elementary school. The purpose of this study is to analyse the application of PBL as a contextual approach to improving elementary school students' understanding of mathematical concepts. This study also aims to identify how active student involvement in problem-solving can help them understand mathematical concepts more deeply and meaningfully. Furthermore, this study is expected to provide an overview of the

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effectiveness of PBL implementation in creating more contextual and participatory mathematics learning. This study can contribute theoretically and practically to the development of mathematics learning in elementary schools. It can also provide a foundation for educational policy development aimed at improving the quality of mathematics learning.

II. METHOD

This research employed a qualitative approach with a case study design. The focus of the research was directed at fifth-grade students and several teachers at SDN 2 Sendang Ponorogo as the primary subjects in examining the phenomenon under study. Data were obtained through participatory observation of the research subjects, either through text, speech, or behaviour. This descriptive or narrative data resulted from the researcher's exploration and understanding of the social community under study. Therefore, this concept serves as the basis for defining the qualitative approach in this study (Waruwu, 2023). The primary data sources in this study include the principal, teachers of SDN 2 Sendang Ponorogo, and fifth-grade students, who were purposefully selected because they were directly involved in the mathematics learning process. Secondary data sources included various supporting documents, such as lesson plans and curriculum modules, student learning records, evaluation tools, teacher journals, and student portfolios. Secondary data sources, on the other hand, refer to the classrooms where the learning process takes place.

Data collection was conducted through participant observation, structured interviews, and document review (Yin, 2017). The researchers used participatory observations to observe teacher activities, student roles, and the implementation of the PBL model in mathematics learning. The researchers conducted structured interviews with the principal, several teachers, and several fifth-grade students to obtain more in-depth information about the role of teachers and the impact of PBL on students' understanding of mathematical concepts. Documentation was used to complement and strengthen data from observations and interviews by reviewing written documents based on relevant learning and school archives (Hafizah et al., 2025). Furthermore, data analysis techniques were conducted using the Miles and Huberman method, which includes three steps: data reduction, data presentation, conclusions, and validation (Miles & Huberman, 1994). Data reduction involves selecting and focusing on information relevant to the research objectives. To facilitate understanding and analysis, researchers present data in narrative and tabular formats, draw conclusions gradually, and continuously verify them to ensure consistency of results. Data validity was tested through triangulation methods, which included comparing the results of observations, interviews, and documentation, as well as source triangulation by verifying information across multiple sources (Chaves, 2021).

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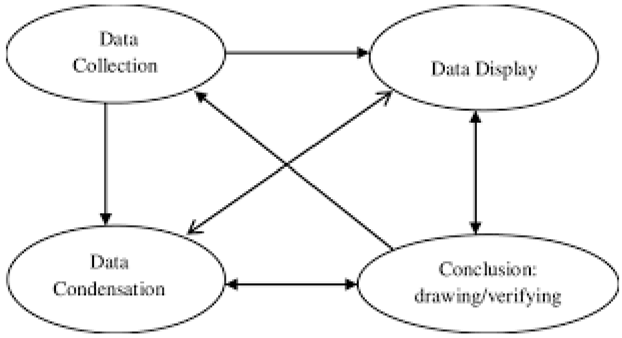

Figure 1*Data Analysis Techniques*

III. RESULT AND DISCUSSION

Implementation of the Problem-Based Learning Model in Mathematics

Research findings indicate that the implementation of the Problem-Based Learning (PBL) model in mathematics instruction at SDN 2 Sendang Ponorogo has had a significant impact on improving students' understanding of mathematical concepts. This finding is evident in increased student engagement in the learning process, their courage to express their opinions, their ability to discuss, and their improved understanding of mathematical concepts learned through everyday life contexts. Prior to the implementation of PBL, the learning process was dominated by lectures and routine practice problems, leading students to tend to memorise formulas without deeply understanding the concepts. This situation aligns with previous research that suggests that teacher-centred mathematics learning results in students being passive and unable to develop optimal conceptual understanding (Stephan, 2020).

However, after implementing the PBL learning model, the teacher is no longer the centre of learning (teacher-centred), but instead acts as a facilitator, guiding students in the process of independently discovering concepts through problem-solving. This demonstrates that the implementation of PBL can create a more active, contextual, and meaningful learning process for elementary school students. These findings align with the constructivist theory, which asserts that knowledge is actively constructed through learning experiences and social interactions (Piaget, 2003; Vygotsky, 1978). In the context of mathematics learning, students not only passively receive information but also construct understanding through exploration, discussion, and reflection on the problems encountered (Ncube & Luneta, 2025). Therefore, the use of contextual problems in PBL helps students connect abstract mathematical concepts with real-world experiences, making the concepts easier to understand.

Research findings also indicate that teachers begin learning by presenting problems related to students' daily lives, then directing students to discuss in groups to find solutions. This strategy demonstrates the application of a contextual learning approach, where subject matter is linked to real-life situations so students can grasp the meaning of the learning. According to Contextual Teaching and Learning (CTL) theory, learning is more effective when students are able to connect the material to their life experiences (Lestari et al., 2021). In elementary school mathematics learning, a contextual approach is crucial because students at the concrete operational stage understand concrete concepts more easily than abstract ones. This aligns with constructivist theory, which views knowledge as something learners actively construct through learning experiences

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(Piaget, 2003). Therefore, the application of real-world PBL provides a more relevant learning experience and enhances students' ability to grasp mathematical concepts in depth. These results support previous research that suggests PBL is effective in helping students build conceptual understanding through collaborative investigation and problem-solving (Thorndahl & Stentoft, 2020).

In addition to improving understanding of mathematical concepts, the implementation of PBL has also been shown to increase student activity and motivation. Observations showed that students appeared more enthusiastic about participating in learning, actively asking questions, and confidently expressing their opinions in group discussions. These findings indicate that PBL can increase student engagement in the learning process. According to constructivist learning motivation theory, students' active involvement in the process of discovering knowledge will increase curiosity, intrinsic motivation, and responsibility for their learning (Ryan & Deci, 2020). In the PBL model, students are given the opportunity to explore ideas and solve problems independently, giving them a sense of ownership of their learning experience. This aligns with previous research that found that the implementation of PBL can increase student motivation because learning becomes more challenging, interactive, and student-centred (Indriyani et al., 2025). Therefore, the results of this study demonstrate that learning mathematics through PBL not only impacts cognitive aspects but also enhances students' affective aspects, such as motivation and self-confidence in learning mathematics.

Furthermore, the results indicate that group discussions in PBL help students develop communication and collaboration skills. Students not only learn to understand mathematical concepts, but also learn to express ideas, listen to their peers' opinions, and collaborate to find solutions. As expressed by a fifth-grade teacher:

> "In PBL learning, students become more active in discussions and are more willing to express their opinions. When given a math problem, they try to find a solution together with their group. Students who were initially passive begin to speak up and contribute ideas during the discussion." (Teacher 1)

This finding aligns with Vygotsky's social constructivism theory, which emphasises the crucial role of social interaction in students' cognitive development. Vygotsky explained that learning occurs through collaboration and interaction with the social environment (social interaction), allowing students to construct new knowledge with the help of peers and teachers (scaffolding) (Vygotsky, 1978). Thus, learning becomes more interactive, collaborative, and student-centred, in line with Vygotsky's principles of social constructivism. This is in line with the results of interviews with several students, which revealed:

> "I understand math more easily when studying in a group because I can ask my friends questions and help each other find the answers." (Student 1)

> "Learning math is more fun because we discuss and find the answers together. If something is difficult, my friends and the teacher help explain it." (Student 2)

Furthermore, the teacher gradually increases the difficulty of the problems so that students can solve them at their own pace. Furthermore, students are grouped based on their abilities and backgrounds. The purpose of these groups is to encourage students to work together, support each other, and discuss challenges. The teacher also stated that heterogeneous grouping enabled students to support one another and collaborate on assignments:

> "Groups are formed based on students' varying abilities so they can support each other. Students who grasp the material more quickly help students who are still struggling, so learning becomes more collaborative." (Teacher 2)

During learning activities, educators provide more intensive support and guidance to students who still have difficulty understanding problems and applying mathematical concepts. The teacher's role as a facilitator is crucial in ensuring that all students actively participate in the dialogue and effectively follow the learning process. The implementation of PBL not only strengthens students' understanding of mathematical concepts but also increases their motivation and engagement in learning activities (Dzulfiansyah et al., 2025). Thus, the learning process becomes more collaborative and student-centred.

The results of this study are also consistent with research by Husnidar & Hayati (2021), which states that the implementation of PBL can improve mathematics learning outcomes because students are actively involved in the learning process. Problem-solving activities in PBL encourage students to think critically, analyse information, and find solutions independently. Similar findings were also presented by Safari & Inayah (2025), who found that the PBL model can increase student engagement and critical thinking skills through group work and collaborative discussions. In this study, students appeared more enthusiastic and confident when expressing their opinions and presenting the results of their group discussions.

The implementation of PBL also increased student learning motivation, demonstrating greater enthusiasm during mathematics learning. Observations showed that the mathematics learning process began with students explaining the objectives to be achieved. The teacher then asked questions about their daily activities relevant to the mathematics material being studied. Afterwards, students were grouped to discuss the given problem. The teacher guided the discussion, asked students to present their work, and concluded the session together. At the beginning of the lesson, the teacher explained common challenges students face in everyday life and then related them to the mathematics topic being studied. This approach aims to engage students and increase enthusiasm for learning. By using illustrations related to everyday experiences, learning becomes more meaningful and easier to understand (Sandi et al., 2024). During the learning activities, the teacher acted as an active supporter and participated in group discussions. The teacher provided guidance and support when students faced challenges and helped students grasp ideas without providing direct answers. This method encourages students to think independently and understand mathematical concepts by solving various problems (Masyitoh et al., 2024).

These findings align with previous research, which states that problem-based learning can increase students' motivation because the learning process becomes more engaging, interactive, and relevant to their lives (Fauzan et al., 2024). The students' active participation indicates that the implementation of the PBL learning model has successfully created a more interactive learning environment. This aligns with the results of interviews with ADP students, who revealed:

> "I am more enthusiastic about learning mathematics because I can learn mathematics through discussions and find answers together" (Student 1).

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On the other hand, this study found that the implementation of PBL still faces several obstacles, such as limited learning time, differences in student abilities, and some students who are less active in group discussions. These findings indicate that the implementation of PBL requires teachers to be prepared to manage learning effectively. According to learning management theory, the teacher's ability to manage time, facilitate student interaction, and create a conducive learning environment influences the success of a learning model (Slavin et al., 2025). This situation aligns with previous research, which explains that teachers' ability to facilitate discussions, manage time, and create a learning environment that supports student participation strongly influences the successful implementation of PBL (Wicaksana et al., 2025). Therefore, teachers need to adopt an adaptive approach and provide special support for students who are still experiencing difficulties.

The results of this study also show that PBL can improve students' critical thinking skills in mathematics. Students are trained to analyse problems, determine problem-solving strategies, and draw conclusions based on the results of group discussions. These activities demonstrate that learning focuses not only on the outcome but also on students' thought processes in understanding mathematical concepts. According to higher-order thinking skills (HOTS) theory, learning that requires students to analyse, evaluate, and solve problems can improve critical thinking skills and conceptual understanding (Brookhart, 2010). In the PBL model, students are encouraged to find solutions independently, resulting in a deeper thinking process than in conventional learning. This finding is supported by research by Wicaksana et al. (2025), which shows that PBL is effective in improving elementary school students' critical thinking skills and understanding of mathematical concepts because students are directly involved in the investigation and problem-solving process.

Overall, the results of this study indicate that the application of PBL in mathematics learning can create a more active, contextual, and meaningful learning process. PBL not only improves students' understanding of mathematical concepts but also develops critical thinking, communication, collaboration, and problem-solving skills. Thus, the implementation of PBL is a relevant approach to support mathematics learning in elementary schools, particularly in improving the quality of students' conceptual understanding sustainably. The following is an illustration of the application of the PBL model applied by a fifth-grade teacher during learning at SDN 2 Sendang:

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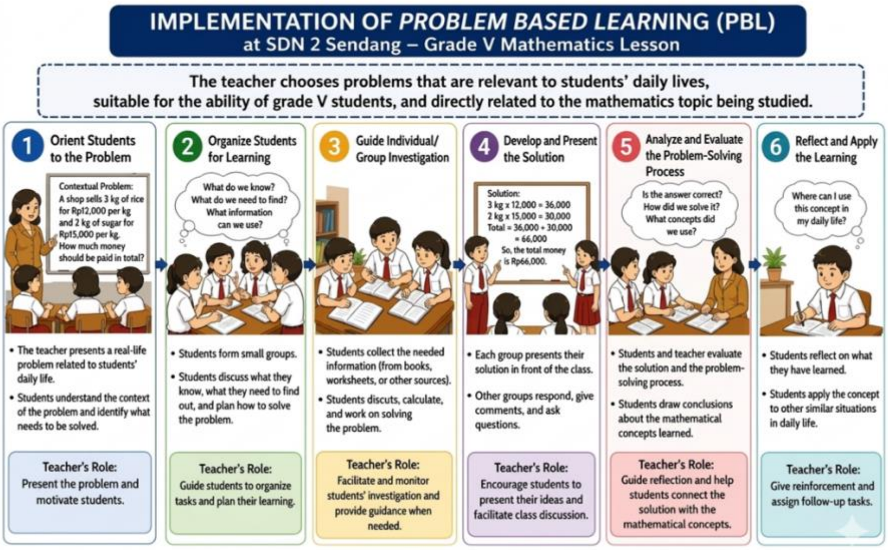

Figure 2. *Illustration of the Implementation of the PBL Model*

Effectiveness of PBL in Improving Elementary Students' Mathematical Understanding

Research results indicate that the implementation of the Problem-Based Learning (PBL) model in fifth-grade students at SDN 2 Sendang Ponorogo proved effective in improving students' understanding of mathematical concepts. This effectiveness was evident from field findings that showed a change in students' ability to understand the meaning of mathematical concepts more deeply, beyond simply memorising formulas and problem-solving procedures. Before the implementation of PBL, most students tended to experience difficulties when faced with problems that differed from the examples provided by the teacher. However, after learning through contextual problems, students were able to connect mathematical concepts to real-life situations, thus enhancing their understanding. These findings indicate that the effectiveness of PBL lies in its ability to provide authentic and contextual learning experiences. This aligns with constructivist theory, which asserts that knowledge cannot be transferred directly from teacher to student but is instead constructed through active learning experiences and the process of making meaning of the situations encountered (Piaget, 2003).

The effectiveness of PBL in this study was also evident in the increased intellectual engagement of students during the mathematics learning process. Students not only act as recipients of information, but also actively analyse problems, identify important information, determine problem-solving strategies, and summarise the results of group discussions. These activities demonstrate an increase in higher-order thinking skills, one of the primary goals of modern mathematics learning (Ghanizadeh et al., 2020). In this context, PBL encourages students to systematically engage in mathematical reasoning, making the concepts learned easier to understand and retain long-term. This finding is relevant to research (Rahmwati & Nurcahya, 2025), which explains that problem-based learning can improve students' conceptual abilities because the learning process focuses on solving real-life problems, not just mechanical exercises.

In addition to impacting cognitive aspects, the effectiveness of PBL is also evident in increased student motivation and confidence in mathematics learning. Observations show that students become more confident in asking questions, expressing opinions, and presenting discussion results to the class. This demonstrates that the PBL model can create

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a more democratic and participatory learning environment. When students are given the opportunity to participate in learning actively, they feel a sense of responsibility for their own learning process. These findings align with Arends (2014) opinion, which states that PBL can increase students' self-confidence and learning independence because they are trained to find solutions independently through exploration and investigation of problems. Previous research also shows that implementing PBL can increase students' intrinsic motivation because learning becomes more engaging, challenging, and relevant to their lives (Jamilah et al., 2025).

This study found that the use of contextual problems is a key factor supporting the effectiveness of PBL in improving mathematical concept understanding. Teachers present math problems in narrative form related to students' daily activities, enabling students to understand the function and benefits of mathematical concepts in real life. This approach helps students reduce the perception that mathematics is abstract and difficult to understand. These findings align with the Realistic Mathematics Education (RME) theory which states that mathematics learning is more effective when linked to students' real-life contexts (Freudenthal, 2002). By presenting realistic problems, students can build mathematical concepts through concrete experiences and meaningful exploration.

The effectiveness of PBL is also evident in the development of students' mathematical communication and collaboration skills during group discussions. Students not only learn to solve problems individually, but also learn to listen to peers' opinions, express ideas, and collaborate to find solutions. This social interaction significantly contributes to the development of students' conceptual understanding. This finding is relevant to social constructivism theory, which emphasises that students' cognitive development occurs through social interaction and collaboration with their surroundings (Vygotsky, 1978). During group discussions, students with higher abilities assist those experiencing difficulties, while teachers provide scaffolding to support students' thinking processes. Thus, learning occurs collaboratively and encourages students to build shared understanding.

The results of this study also indicate that the effectiveness of PBL is influenced by the supportive school environment and teachers' readiness to design learning. The principal provides support through innovative learning policies, supervision of the learning process, and provision of facilities that support the implementation of PBL. This support allows teachers more freedom to develop creative learning strategies tailored to students' needs. These findings support research by Hervianti et al. (2025), which states that the success of PBL is not solely determined by the learning model itself, but is also influenced by teacher competence, school support, and the quality of lesson planning. Teachers who are able to design contextual problems appropriately will more easily create effective and meaningful learning for students.

The effectiveness of PBL in this study is further strengthened by data on the distribution of student learning outcomes, which shows an increase in scores after the implementation of the problem-based learning model. Before the implementation of PBL, the average student learning outcome was still between 60 and 65, categorised as inadequate. However, after the implementation of PBL, the score increased to 80, categorised as good. The following is a bar graph before and after the implementation of the PBL program for fifth graders at SDN 2 Sendang Ponoroogo:

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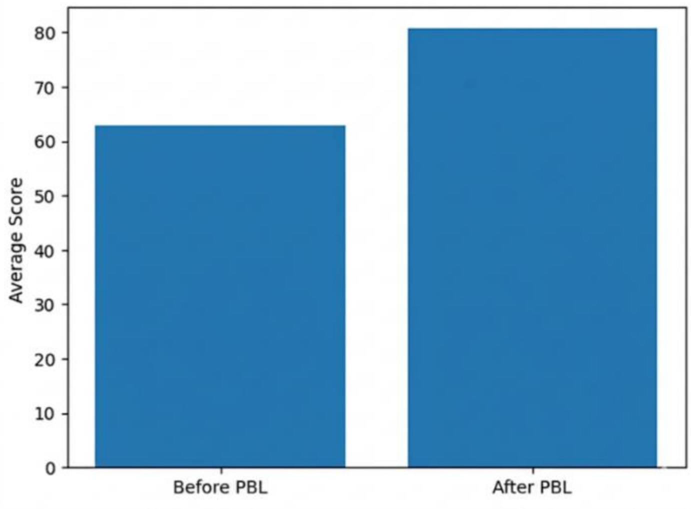

Figure 3. *Bar Chart of Distribution of Values Before and After PBL*

This improvement demonstrates that students' active involvement in learning has a significant impact on their understanding of mathematical concepts. Other research has also found that PBL can improve mathematics learning outcomes because students better understand the problem-solving process rather than simply memorising procedural steps (Situmorang & Laksono, 2025). In other words, the effectiveness of PBL lies in its ability to help students understand concepts in depth, thereby making the acquired knowledge more durable. Furthermore, field findings indicate that problem-focused teaching methods can significantly improve students' understanding of mathematical concepts. Field findings revealed that students became more enthusiastic during group discussions, felt more confident in expressing their opinions, and were able to connect mathematics lessons to real-world situations around them. These changes reflect a shift from a teacher-dominated learning system to a more student-centred learning system, where students independently construct their understanding through problem-solving.

However, this research also identified several challenges in implementing PBL, primarily related to limited learning time and differences in student abilities. Teachers needed more time to manage group discussions, guide students, and ensure all students were actively involved in the learning process. Furthermore, students' heterogeneous abilities mean that some students require more intensive guidance than others. However, teachers attempt to overcome this obstacle through heterogeneous grouping and providing gradual guidance according to students' abilities. This finding aligns with previous research, which explains that time management and forming diverse groups are efficient methods for addressing differences in ability among participants (Prasetyono, 2025).

Overall, the results of this study indicate that the PBL model is effective in improving elementary school students' understanding of mathematical concepts because it creates active, contextual, collaborative, and meaningful learning. This effectiveness is not only evident in improved student learning outcomes but also in the development of critical thinking, communication, collaboration, and self-confidence in mathematics learning. Therefore, PBL can be a relevant alternative learning model to support 21st-century mathematics learning and the implementation of the Independent Curriculum in elementary schools.

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Supporting Factors and Obstacles to Problem-Based Learning Implementation

Research results indicate that the successful implementation of Problem-Based Learning (PBL) in mathematics learning at SDN 2 Sendang Ponorogo is influenced by various supporting factors originating from teachers, students, and the school environment. One of the main factors contributing to the success of PBL implementation is the school's institutional support for the use of innovative learning models. The principal implements policies that support active learning in accordance with the Merdeka Curriculum, such as giving teachers the freedom to develop learning methods, providing learning facilities, and conducting regular supervision and evaluation. This support creates a conducive academic environment for teachers to implement problem-based learning. This finding aligns with research (Hervianti et al., 2025), which states that the success of PBL implementation is significantly influenced by school support through academic policies, learning supervision, and strengthening teacher competencies. A school environment that supports learning innovation will help teachers become more confident in implementing student-centred learning strategies.

In addition to school support, teacher readiness is also a crucial factor in supporting PBL implementation. The research results show that teachers were able to design learning through the development of teaching modules systematically, the identification of contextual problems, student grouping, and the development of evaluation instruments appropriate to the characteristics of PBL. Teachers also played an active role as facilitators, guiding students during discussions and problem-solving. Teachers' ability to manage the classroom and provide scaffolding to students was a key determinant of the success of problem-based learning. This aligns with social constructivism theory, which emphasises the crucial role of teachers as mediators in helping students reach their zone of proximal development (ZPD) by providing gradual assistance tailored to their needs (Vygotsky, 1978). In this study, teachers did not directly provide answers to students but instead provided prompting questions and guidance that helped students find solutions independently. This strategy was proven to increase student engagement in the mathematics learning process.

Another supporting factor was the use of contextual problems related to students' daily lives. Teachers connected mathematics material to real-life situations, making it easier for students to grasp the concepts being learned. Realistic problems made students feel that mathematics had a direct connection to their lives. This increased student interest and motivation to participate in the learning process. These findings align with Realistic Mathematics Education (RME) theory, which states that mathematics learning will be more meaningful when linked to students' real-life experiences (Freudenthal, 2002). Other research also shows that the use of contextual problems in PBL can increase elementary school students' learning motivation and conceptual understanding because students more easily construct knowledge through concrete experiences (Rahmadhani et al., 2024).

Student enthusiasm and active participation during learning are also contributing factors to the success of PBL implementation. Based on observations, students appeared more active in discussions, asking questions, expressing opinions, and working collaboratively in groups. The social interactions that occur during learning help students understand mathematical concepts more deeply. Group discussions provide opportunities for students to exchange ideas and learn from the experiences of their peers. These findings support the theory of social constructivism, which asserts that knowledge is constructed through social interaction and collaboration (Vygotsky, 1978). Other research also suggests that PBL can increase students' social and emotional engagement because students are given space to actively participate in the learning process (Jamilah et al., 2025).

In addition to these supporting factors, this study also identified several obstacles in the implementation of PBL. One major obstacle is limited learning time. PBL requires more time than conventional learning because students must go through the stages of understanding the problem, discussing it, finding solutions, presenting results, and reflecting on their learning. Time management challenges often prevent teachers from implementing all stages of PBL effectively within the available instructional time. This finding aligns with previous research, which explains that time management is a major challenge in implementing PBL in elementary schools, especially when teachers must guide entire groups of students simultaneously (Prasetyono, 2025).

Another obstacle identified is the differences in students' academic abilities in understanding mathematics. Not all students have the same thinking skills and learning speeds, so some require more intensive guidance than others. In group discussions, some students tend to be active, while lower-ability students are sometimes passive and lack confidence in expressing their opinions. This situation requires teachers to pay special attention to ensure all students are optimally involved in the learning process. This finding is relevant to research stating that heterogeneity in student abilities poses a challenge in implementing PBL because teachers need to adapt learning strategies to the varying characteristics and learning needs of students (Situmorang & Laksono, 2025).

Furthermore, teachers' ability to manage group dynamics also presents a challenge in implementing PBL. In some situations, group discussions are not effective because some students still rely on more active peers. Teachers need to ensure that each group member has equal responsibility and opportunity to express ideas and complete group assignments. Therefore, teachers' skills in supervising, reinforcing, and assigning roles within groups are crucial factors in creating effective collaborative learning. Previous research has shown that the success of group discussions in PBL is greatly influenced by the teacher's ability to build communication and cooperation among group members (Mangaraja et al., 2025; Sevani & Ramadan, 2023).

Despite facing various obstacles, teachers at SDN 2 Sendang Ponorogo have made various efforts to overcome these obstacles. Teachers implement heterogeneous grouping strategies so that students can support each other in the learning process. In addition, teachers provide additional guidance to students who have difficulty understanding the material and manage learning time more flexibly. Teachers also use engaging activities such as educational games and contextual questions to increase student participation during learning. These strategies demonstrate that the success of PBL implementation is not solely determined by the learning model itself, but also by teachers' creativity in managing the learning process.

Overall, the results of this study indicate that the implementation of PBL in mathematics learning in elementary schools is influenced by a combination of interrelated supporting and inhibiting factors. School support, teacher readiness, the use of contextual problems, and active student participation are key factors contributing to the success of PBL. Meanwhile, time constraints, heterogeneity in student abilities, and the management of group discussions are challenges that need to be addressed strategically. These findings demonstrate that PBL implementation requires comprehensive preparation, encompassing pedagogical, managerial, and school environmental aspects, to achieve learning objectives optimally.

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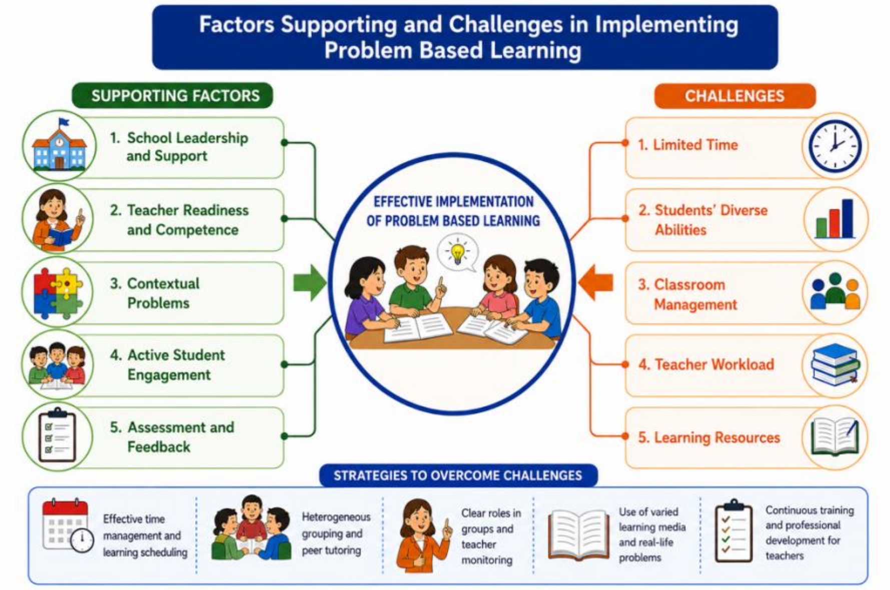

Figure 4. *Factors Supporting and Challenges in Implementation of the PBL Model*

IV. CONCLUSION

The findings indicate that the Problem-Based Learning (PBL) model supports active, contextual, and student-centered mathematics learning among fifth-grade students at SDN 2 Sendang Ponorogo. PBL implementation follows six main stages: orienting students to the problem, organising students for learning, guiding investigation, developing and presenting the work, evaluating problem-solving, and reflecting and applying. Through these stages, students not only understand mathematical concepts theoretically but are also able to relate them to real problems in everyday life. The teacher acts as a facilitator who guides students in the discussion and problem-solving process so that learning becomes more meaningful. The results of the study indicate that the implementation of PBL effectively improves students' understanding of mathematical concepts. This is evident in increased student engagement, the ability to work together, the courage to express opinions, as well as critical thinking and problem-solving skills. In addition, student learning outcomes have improved from the "inadequate" category to "good" after the implementation of PBL. This finding is in line with Vygotsky's social constructivism theory and Freudenthal's realistic mathematics education, which emphasise the importance of social interaction and contextual experiences in learning. Teacher readiness, principal support, contextual problems, and a collaborative learning environment contribute to the effective implementation of PBL. However, the study also identified obstacles such as time constraints, differences in student abilities, and low participation of some students in group discussions. Therefore, effective learning management is necessary for optimal PBL implementation. This research highlights the importance of developing innovative, interactive mathematics learning that is oriented toward strengthening elementary school students' critical thinking skills.

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V. REFERENCES

[1] Amir, F., Firdaus, Fery Muhamad, & Pada, A. (2024). How does Realistic Mathematics Learning Shape Learners' Problem Solving and Critical Thinking Skills? *AL-ISHLAH: Jurnal Pendidikan*, *16*(3). https://doi.org/10.35445/alishlah.v16i3.5101

[2] Aprilita, T. D., & Handican, R. (2023). Persepsi Siswa Terhadap Implementasi Model Problem Based Learning pada Mata Pelajaran Matematika. *Griya Journal of Mathematics Education and Application*, *3*(3), 546–560. https://doi.org/10.29303/griya.v3i3.353

[3] Arends, R. (2014). *Learning to teach*. McGraw-Hill Higher Education.

[4] Brookhart, S. M. (2010). *How to assess higher-order thinking skills in your classroom*. Ascd.

[5] Chaves, V. E. J. (2021). Triangulación metodológica cualitativa y cuantitativa. *Revista Sobre Estudios e Investigaciones Del Saber Académico*, *14*, 76–81. https://doi.org/10.70833/rseisa14item276

[6] Dzulfiansyah, M. F., Azimah, R. N., Jarisma, D., & Hernaeny, U. (2025). Systematic Literature Review (SLR): Pendekatan Problem-Based Learning sebagai Solusi Peningkatan Pemahaman Konsep pada Siswa SMA Kelas XI pada Materi Konsep Derivatif. *Nusantara Journal of Education and Social Science*, *2*(2), 37–45. https://doi.org/10.69959/nujess.v2i2.109

[7] Fauzan, M., Qolbi, M. F., Suriansyah, A., & Cinantya, C. (2024). Pembelajaran Matematika di Sekolah Dasar dengan Menggunakan Model Problem Based Learning. *MARAS: Jurnal Penelitian Multidisiplin*, *2*(4), 1832–1840. https://doi.org/10.60126/maras.v2i4.529

[8] Freudenthal, H. (2002). Didactical Principles. In *Revisiting Mathematics Education* (pp. 45–123). Kluwer Academic Publishers. https://doi.org/10.1007/0-306-47202-3_2

[9] Ghanizadeh, A., Al-Hoorie, A. H., & Jahedizadeh, S. (2020). *Higher Order Thinking Skills*. Cham: Springer International Publishing.. https://doi.org/10.1007/978-3-030-56711-8_1

[10] Guerrero, R. J. A., Pacheco, D. A. A., Quiñonez, E. D. R., Mina, J. J. S., Mina, R. R. S., & Mina, A. N. S. (2025). Desarrollo de habilidades de pensamiento crítico mediante problemas de matemáticas aplicadas. *Star of Sciences Multidisciplinary Journal*, *2*(1), 2. https://doi.org/10.5281/zenodo.15319568

[11] Hafizah, N., P, T. C. P., Sari, M., Winanda, R., Hidayatullah, R., & Harmonedi, H. (2025). Identifikasi Variabel Penelitian, Jenis Sumber Data Dalam Penelitian Pendidikan. *Jurnal QOSIM Jurnal Pendidikan Sosial & Humaniora*, *3*(2), 586–596. https://doi.org/10.61104/jq.v3i2.1025

[12] Hervianti, V., Joko, J., Anifah, L., & Buditjahjanto, I. G. P. A. (2025). Penerapan Model Pembelajaran Problem Based Learning untuk Meningkatkan Pemahaman Konsep Barisan dan Deret pada Siswa SMK. *JIIP - Jurnal Ilmiah Ilmu Pendidikan*, *8*(11), 12362–12369. https://doi.org/10.54371/jiip.v8i11.9660

e-ISSN: 2528-0465 (online) / Volume 11, Issue 1, 2026
p-ISSN: 2503-5363 (print)

[13] Husnidar, H., & Hayati, R. (2021). Penerapan model pembelajaran problem based learning untuk meningkatkan hasil belajar matematika siswa. *Asimetris: Jurnal Pendidikan Matematika Dan Sains*, *2*(2), 67–72. https://doi.org/10.51179/asimetris.v2i2.811

[14] Ibrahim, Almukarramah, Gunawan, Marwan, & Don, Y. (2020). Implementation of problem-based learning to improve students' critical thinking skills. *Journal of Physics: Conference Series*, *1460*, 012058. https://doi.org/10.1088/1742-6596/1460/1/012058

[15] Indriyani, H. K., Purwaningsih, D., & Khaokhajorn, W. (2025). The Effects of Problem-Based Learning on Critical Thinking, Motivation, and Learning Outcomes in Indonesia: A Systematic Review. *Jurnal Pendidikan MIPA*, *26*(3), 1750–1777. https://doi.org/10.23960/jpmipa.v26i3.pp1750-1777

[16] Jamilah, R., Hernawati, D., Fazza, A. U., & Wanda, R. A. (2025). Implementasi Model Pembelajaran Problem Based Learning untuk Meningkatkan Kemampuan Pemahaman Matematika di SDN Pasirkukun 03. *Sindoro: Cendikia Pendidikan*, *16*(11), 51–60. https://doi.org/10.99534/mgqgwh12

[17] Johnson, E. B. (2002). *Contextual teaching and learning: What it is and why it's here to stay*. Corwin Press.

[18] Kholid, M. N., Imawati, A., Swastika, A., Maharani, S., & Pradana, L. N. (2021). How are Students' Conceptual Understanding for Solving Mathematical Problem? *Journal of Physics: Conference Series*, *1776*(1), https://doi.org/10.1088/1742-6596/1776/1/012018

[19] Lestari, F. P., Ahmadi, F., & Rochmad, R. (2021). The Implementation of Mathematics Comic through Contextual Teaching and Learning to Improve Critical Thinking Ability and Character. *European Journal of Educational Research*, *10*(1), 497–508. https://doi.org/10.12973/eu-jer.10.1.497

[20] Mangaraja, A., Ammy, P. M., & Sinulingga, H. M. T. (2025). Peningkatan Pemahaman Konsep Matematika Siswa Melalui Model PBL (Problem Based Learning) Di UPT SMP N 16 Medan. *Journal Mathematics Education Sigma [JMES]*, *6*(1). https://doi.org/10.30596/jmes.v6i1.19748

[21] Masyitoh, A., Safmi, C. A., & Gusmaneli. (2024). Peran Guru dalam Membangun Kepercayaan Diri Siswa melalui Pembelajaran Aktif di Kelas Dasar. *Journal Educational Research and Development, 1(2), 89–95.* https://doi.org/10.62379/jerd.v1i2.58

[22] Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. sage.

[23] Ncube, M., & Luneta, K. (2025). Concept-based instruction: Improving learner performance in mathematics through conceptual understanding. *Pythagoras-Journal of the Association for Mathematics Education of South Africa*, *46*(1), 815. https://doi.org/https://hdl.handle.net/10520/ejc-amesap_v46_n1_a815

[24] Piaget, J. (2003). Cognitive Development in Children-Piaget Development and Learning. *Journal of Research in Science Teaching*, *40*. https://eric.ed.gov/?id=ej773455

[25] Prasetyono, H. (2025). Eksplorasi persepsi guru dan siswa terhadap implementasi PBL dalam Evaluasi Pembelajaran IPA di SMPN 2 Pasawahan Kabupaten Purwakarta (Studi wawancara mendalam tentang tantangan dan keunggulan penerapan PBL). *Pendas: Jurnal Ilmiah Pendidikan Dasar*, *10*(04), 317–348. https://doi.org/10.23969/jp.v10i04.34224

[26] Rafiq, A. A., Triyono, M. B., & Djatmiko, I. W. (2023). The Integration of Inquiry and Problem-Based Learning and Its Impact on Increasing the Vocational Student Involvement. *International Journal of Instruction*, *16*(1), 659–684. https://doi.org/10.29333/iji.2023.16137a

[27] Rahayu, S., Warsinih, W., & Rasilah, R. (2024). Increasing Student Learning Motivation in Mathematics Learning: Literatur Review. *Journal of Mathematics Instruction, Social Research and Opinion*, *3*(3), 311–318. https://doi.org/10.58421/misro.v3i3.277

[28] Rahmadhani, P. A., Farahsanti, I., & Ariyanto, E. (2024). Increasing Students' Activity and Understanding of Concepts in Mathematics Learning Using Lesson Study-Based PBL. *Jurnal Pendidikan Matematika (JPM)*, *10*(2), 185–191. https://doi.org/10.33474/jpm.v10i2.21867

[29] Rahmwati, D., & Nurcahya, I. (2025). Efektivitas Problem Based Learning dalam Meningkatkan Pemahaman Konsep Matematika di Sekolah Dasar. *Karimah Tauhid*, *4*(9), 6516–6527. https://doi.org/10.30997/karimahtauhid.v4i9.20377

[30] Ryan, R. M., & Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary Educational Psychology*, *61*, 101860. https://doi.org/10.1016/j.cedpsych.2020.101860

[31] Sa'diyah, M., Sa'dijah, C., & Susiswo, S. (2024). Students' Ability to Formulate Situation Mathematically from Context-Based Mathematics Problems. *TEM Journal*, 1443–1451. https://doi.org/10.18421/TEM132-58

[32] Safari, Y., & Inayah, Y. (2025). Studi Literatur: Efektivitas Model Pembelajaran Matematika di Sekolah Dasar dalam Implementasi Kurikulum Merdeka. *POLINOMIAL: Jurnal Pendidikan Matematika*, *4*(1), 154–164. https://doi.org/10.56916/jp.v4i1.1500

[33] Sandi, N. R., Nisa, S., & Suriani, A. (2024). Penggunaan Model Pembelajaran Problem Based Learning Dalam Meningkatkan Minat Belajar Siswa. *Dewantara : Jurnal Pendidikan Sosial Humaniora*, *3*(2), 294–303. https://doi.org/10.30640/dewantara.v3i2.2654

[34] Santi, C., Helmon, A., & Sennen, E. (2021). Pembelajaran Pemecahan Masalah Matematika di Sekolah Dasar. *Jurnal Literasi Pendidikan Dasar*, *2*(2), 31–40. https://doi.org/10.36928/jlpd.v2i2.2154

e-ISSN: 2528-0465 (online) / Volume 11, Issue 1, 2026
p-ISSN: 2503-5363 (print)

[35] Sari, A. M. Z., Sari, F. A., & Sukriadi, S. (2026). Penerapan Problem-based Learning dengan Pendekatan Pembelajaran Berdiferensiasi untuk Meningkatkan Kemampuan Komunikasi Matematis. *Jurnal Pendidikan Matematika dan Sains*, *14*(1), 164–178. https://doi.org/10.21831/jpms.v14i1.91682

[36] Sella, F. A., Harahap, K. S., Sintia, L., Khairani, S., Mailani, E., & Ketaren, M. A. (2024). Pengaruh Pendekatan Realistik Dalam Pembelajaran Matematika Terhadap Pemecahan Masalah Siswa SD. *Jurnal Motivasi Pendidikan dan Bahasa*, *2*(4), 87–94. https://doi.org/10.59581/jmpb-widyakarya.v2i4.4296

[37] Sevani, O., & Ramadan, Z. H. (2023). The Effectiveness of Project-Based Learning Model in Increasing Understanding of Mathematical Concepts in Fourth-Grade Elementary School Students. *Journal of Education Research and Evaluation*, *7*(3), 469–476. https://doi.org/10.23887/jere.v7i3.66664

[38] Situmorang, S. S., & Laksono, E. W. (2025). Penerapan Problem-based Learning terhadap Kemampuan Berpikir Kritis dan Keaktifan Belajar Peserta Didik. *Jurnal Pendidikan Matematika Dan Sains*, *13*(Special_issue), 283–294. https://doi.org/10.21831/jpms.v13iSpecial_issue.89598

[39] Slavin, R. E., Madden, N., & Ross, S. (2025). *Educational psychology: Theory and practice*. Pearson. https://eric.ed.gov/?id=ED676836

[40] Stephan, M. (2020). Teacher-Centered Teaching in Mathematics Education. In *Encyclopedia of Mathematics Education* (pp. 836–840). Springer International Publishing. https://doi.org/10.1007/978-3-030-15789-0_150

[41] Thorndahl, K. L., & Stentoft, D. (2020). Thinking Critically About Critical Thinking and Problem-Based Learning in Higher Education: A Scoping Review. *Interdisciplinary Journal of Problem-Based Learning*, *14*(1). https://doi.org/10.14434/ijpbl.v14i1.28773

[42] Vygotsky, L. S. (1978). *Mind in Society: The Development of Higher Psychological Processes.* MA: Harvard University Press.

[43] Waruwu, M. (2023). Pendekatan Penelitian Pendidikan: Metode Penelitian Kualitatif, Metode Penelitian Kuantitatif dan Metode Penelitian Kombinasi (Mixed Method). *Jurnal Pendidikan Tambusai*, *7*(1), 2896–2910. https://doi.org/10.31004/jptam.v7i1.6187

[44] Wicaksana, L., Widiarti, N., & Subali, B. (2025). Kajian Pustaka: Realistic Mathematics Education Terhadap Kemampuan Berpikir Kritis Siswa Sekolah Dasar. *Jurnal Penelitian Pendidikan*, *25*(2), 158–173. https://doi.org/10.17509/jpp.v25i2.83608

[45] Wijayanti, S. D., Taqiya, I., Sari, F. K., & Amaliyah, F. (2025). Application of The Problem-Based Learning Model to Improve Students' Mathematical Problem-Solving Abilities in Elementary School. *Riemann: Research of Mathematics and Mathematics Education*, *7*(2), 131–138. https://doi.org/10.38114/reimann.v7i2.59

[46] Yabashiru, F., Apriza, B., & Dinata, K. B. (2025). Mathematics Learning Difficulties among Elementary School Students. *Journal for Lesson and Learning Studies*, *8*(2), 304–315. https://doi.org/10.23887/jlls.v8i2.94756

[47] Yin, R. K. (2017). *Case study research and applications: Design and methods*. Sage publications.

DOI: https://doi.org/10.35723/jie.v11i1.739