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Implementation of Problem Based Learning (PBL) Learning Model in Mathematics Subjects at Madrasah Ibtidaiyah

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ABSTRACT

Learning mathematics is a scourge for students; mathematics is considered difficult and scary, so it takes effort from a teacher to achieve the expected goals and fun. Mathematics requires a learning model to help students feel comfortable and happy; it is no longer a lesson they fear but a subject of interest. This study aims to provide solutions to students to follow the learning maximally and according to the goals to be achieved. This study is a type of qualitative descriptive research. The subjects in this study were teachers in MI Darussa'adah Domasan Kalidawir Tulungagung—data collection methods using observation, interviews, and documentation. Data analysis techniques used are data reduction, data presentation, and conclusion. The results of this study explain that mathematics teachers apply the PBL model with several steps according to PBL syntax. Teachers experience several obstacles in using the Problem-Based Learning model, namely, lack of learning resources, lack of students' literacy skills, and limited time. However, the problem-based learning model has advantages in improving mathematics learning activities, including achieving goal activities so students can receive and achieve the target reference value or KKM.

INTRODUCTION

The passage highlights the essential role of education in shaping individuals and society, with mathematics playing a crucial part in personal and national development. Mathematics is key to scientific and technological progress, serving as a tool across fields like engineering, physics, and economics. Mastering mathematics fosters reasoning and decision-making skills, critical in today's competitive world (Cheng et al., 2015; Yeh et al., 2019; Siagian, 2016; Dewi & Wijayanti, 2022). Starting in elementary school, mathematics education focuses on building cognitive skills, enhancing problem-solving, and stimulating interest in learning. The PAIKEM approach (Pembelajaran Aktif, Inovatif, Kreatif, Efektif, dan Menyenangkan) is designed to make learning engaging and practical, promoting active and creative thinking (Astuti, 2021; Nashrullah et al., 2023). Scholars such as Pertiwi (2018), Ali (2019), and Susilo (2022) emphasize that this method encourages critical thinking and problem-solving, tailored to the cognitive development of young learners, helping them apply mathematical concepts to real-life situations (Sun & Hui, 2012; Puspaningtyas, 2019).

Mathematics is often perceived as a challenging subject due to its abstract nature and extensive use of numbers, which can create reluctance and anxiety among students. To address this, innovative teaching methods such as Problem-Based Learning (PBL) have been introduced to make mathematics more accessible and engaging. PBL focuses on using real-life problems as a foundation for learning, encouraging critical thinking, problem-solving, and improved communication skills (Ahmed et al., 2012; Rozgonjuk et al., 2020; Khasawneh et al., 2021). By placing students at the center of the learning process, PBL fosters active participation and collaboration, helping students connect mathematical concepts to their daily lives, thus enhancing motivation and understanding (Fauzia, 2018). Studies by Uden and Beaumont highlight the benefits of PBL, such as improved knowledge

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retention and reasoning skills (Ruminawati et al., 2018). Despite its advantages, PBL also presents implementation challenges, particularly in mathematics. Research shows that PBL can significantly improve learning outcomes (Ruminawati et al., 2018; Taspiah, 2021), stimulate critical thinking (Masrinah, 2019), and foster student engagement, as observed in MI Darussa'adah Domasan, Kalidawir, Tulungagung, where PBL enhanced students' math scores and collaborative learning.

This study aims to explore and examine the implementation of the Problem-Based Learning (PBL) model in mathematics lessons at MI Darussa'adah Domasan, Kalidawir District, Tulungagung Regency. The specific objectives are to identify the essence of applying the PBL model in mathematics, uncover the challenges faced by teachers in its implementation, and analyze the benefits gained from its use. This research is expected to provide several benefits. For teachers, it offers insights into the effectiveness of PBL in enhancing student motivation and participation in mathematics learning, as well as solutions to challenges encountered in its application. For students, it helps them better understand mathematical concepts through problem-solving approaches related to real-life situations, improving their learning outcomes. For the school, it serves as a reference for developing innovative teaching models for other subjects, enhancing the overall quality of education. Additionally, for other researchers, the study provides empirical data on PBL implementation, which can be used as a reference for similar research in education.

Based on the objectives of this study, the research hypothesizes that the implementation of the Problem-Based Learning (PBL) model in mathematics lessons at MI Darussa'adah Domasan will enhance students' motivation and participation in the learning process. Furthermore, the use of PBL is expected to help students better understand mathematical concepts through problem-solving approaches that relate to real-life situations, thus improving their learning outcomes. However, despite its effectiveness, the implementation of PBL may present certain challenges and obstacles for teachers. Additionally, the application of this model is anticipated to benefit the school by serving as a reference for the development of innovative teaching methods in other subjects.

RESEARCH METHODS

The approach used in this research is a descriptive qualitative approach, utilizing the Miles & Huberman analysis technique, which involves collecting data until reaching a point of saturation—when no new or relevant data is being found. This ensures that all significant aspects of the research problem are captured and examined thoroughly (Sugiyono, 2015). Descriptive qualitative research is particularly effective in educational settings, as it provides a deeper understanding of specific phenomena by exploring the context in which they occur (Merriam & Tisdell, 2016). This study aims to investigate the application of the Problem-Based Learning (PBL) model in mathematics lessons at MI Darussa'adah Domasan, Kalidawir District, Tulungagung Regency, to uncover the learning stages, challenges, and supporting factors involved in this teaching method. The researcher’s role is pivotal in qualitative research, where they serve as the primary instrument for data collection, interpretation, and analysis. According to Creswell & Poth (2018), the researcher becomes immersed in the environment they are studying, allowing for the collection of rich, detailed data that provides a more comprehensive understanding of the subject matter. In this study, the researcher directly participates in observing the implementation of the PBL model in mathematics, which aligns with Patton’s (2002) emphasis on the importance of the researcher’s active involvement in gathering contextualized and nuanced data in qualitative inquiry.

One of the primary advantages of the descriptive qualitative approach is its flexibility and adaptability. Bogdan & Biklen (2007) highlight that this approach enables the researcher to capture complex interactions and subtle dynamics within educational settings that may not be easily quantifiable. In this study, it allows the researcher to identify both the barriers and facilitators of the PBL model as experienced by teachers and students. This is crucial in understanding the real-life application of PBL, as it often involves complex, problem-solving tasks that require students to engage critically with the material (Barrows, 1986; Hmelo-Silver, 2004). Furthermore, qualitative research emphasizes the importance of understanding the participant's perspective, which is essential

when examining the learning processes and outcomes within the PBL framework. Denzin & Lincoln (2011) assert that qualitative research aims to capture the lived experiences of participants, providing insights into how students and teachers navigate the learning challenges associated with PBL. In this context, the researcher is expected to observe how PBL influences students' engagement, collaboration, and problem-solving abilities, as well as the teachers' role in facilitating this learning model (Hmelo-Silver et al., 2007).

Additionally, Vygotsky's (1978) socio-cultural theory is relevant here, as it underpins the PBL approach, emphasizing the role of social interaction and collaboration in cognitive development. In PBL, students work in groups to solve real-world problems, which aligns with Vygotsky's concept of the Zone of Proximal Development (ZPD), where students learn more effectively with peer collaboration and guidance from more knowledgeable others, such as teachers. By using the descriptive qualitative approach, this research will also contribute to the broader discourse on PBL as a pedagogical strategy, particularly in the context of mathematics education. Hmelo-Silver (2004) and Savery (2006) emphasize that PBL promotes deeper learning and the development of critical thinking skills by engaging students in authentic, real-world problem-solving tasks. Therefore, understanding its implementation, benefits, and challenges within the specific context of MI Darussa'adah Domasan can offer valuable insights for educators, policymakers, and researchers interested in applying PBL to enhance educational outcomes.

In conclusion, this research employs a descriptive qualitative approach with the Miles & Huberman analysis technique to examine the implementation of PBL in mathematics lessons at MI Darussa'adah Domasan, providing an in-depth exploration of both the obstacles and benefits experienced during the learning process. Through active participation and detailed observation, the researcher seeks to contribute valuable empirical data to the field of education, particularly in the use of PBL as a strategy for improving student engagement and understanding in mathematics.

RESULTS And DISCUSSION

Results

Researchers carry out a series of stages in data collection, namely by conducting observations, interviews, and documentation. Observations made by researchers by following a series of mathematics learning activities with the application of the problem-based learning (PBL) learning model at MI Darussa'adah Domasan Kec. Kalidawir Kab. Tulungagung. The series of learning activities are carried out solemnly and conducive so as to increase the level of success in teaching and learning activities. From the observations made, researchers found a condition that the teacher was able to provide teaching and learning activities that were friendly and comfortable for students, as well as students being able to participate in activities with enthusiasm.

The following are several research findings related to the application of the problem based learning (PBL) learning model at MI Darussa'adah Domasan District. Kalidawir District. Tulungagung:

Mathematics Subject Teachers Carry Out The Steps For Implementing The Problem Based Learning (PBL) Learning Model

Mathematics teachers at MI Darussa'adah Domasan, Kalidawir District, Tulungagung Regency, implement the Problem-Based Learning (PBL) model in a structured manner. The process begins with the teacher greeting the class and leading a group prayer. Before starting the lesson, the teacher takes attendance, allowing them to monitor student presence and well-being. Following this, the teacher engages students in a brief review of previously covered material, linking it to the upcoming lesson. The teacher outlines the learning objectives, ensuring that students understand the competencies they are expected to achieve. A simple explanation of the PBL model is provided to ensure students grasp the steps involved in the learning process. The students are then divided into groups, either randomly or by balancing high and low math abilities. The teacher hands out worksheets containing real-world, problem-based tasks. Students work collaboratively within their groups to address and solve the problems presented.

The teacher guides students individually and in groups, helping them find the necessary information to solve assigned problems. Students then compile their solutions into reports, which may include documentation or recordings. Randomly selected students present their group's solutions, followed by teacher feedback on their work. After presentations, the teacher encourages discussion, allowing students to ask questions and provide feedback. The lesson concludes with a summary and a brief assessment, with students submitting their worksheets. Interviews with teachers and students at MI Darussa'adah Domasan, Kalidawir District, reveal that the Problem-Based Learning (PBL) model was chosen to engage students in mathematics by relating the subject to real-life scenarios. Teacher Luluk Insiatin explained that this approach helps motivate students, especially in a subject many find difficult. The PBL model fosters critical thinking and active participation, making learning more engaging and relevant to students' daily lives.

Teachers Benefit From Implementing The Problem-Based Learning Model In Mathematics Subjects

Teachers benefit from using the problem-based learning (PBL) model in mathematics lessons, as it increases student enthusiasm and participation. The model encourages students to express their ideas and opinions during the learning process while fostering creativity and critical thinking when analyzing lesson materials. During interviews, mathematics teachers at MI Darussa'adah Domasan, Kalidawir District, Tulungagung Regency, shared their experiences with the PBL model. Siti Mu'awanah, a math teacher, highlighted the positive impact of the PBL model, noting that it helps engage students and reduces boredom. According to her, students are more eager to participate in activities, especially in group work, where they become more active in asking questions and expressing opinions. The collaborative nature of PBL also encourages peer support and critical thinking as students work together to solve problems related to their daily lives (personal communication, September 7, 2023).

However, challenges were also mentioned by teachers. M. Badrul Munir pointed out the lack of media and learning resources as a significant obstacle in implementing the PBL model. While the teacher adapts questions to the students' environmental context, the limited availability of instructional materials and students' low literacy levels remain areas for improvement (personal communication, September 7, 2023). Students shared their perspective on the PBL model, with Ahmad Rifa'i Zamzami stating that he enjoys mathematics more when the teacher introduces new ways of learning. He appreciates the group work aspect, which feels both educational and entertaining, though he sometimes feels that time passes quickly during lessons (personal communication, September 7, 2023). In summary, both teachers and students find the PBL model beneficial in creating a more engaging and interactive learning environment, despite facing some challenges with resources and literacy levels.)

Teachers Experience Obstacles In Problem-Based Learning Models In Mathematics Subjects

Teachers face several challenges in implementing the problem-based learning (PBL) model in mathematics at MI Darussa'adah Domasan, Kalidawir District, Tulungagung Regency. These include a lack of learning resources, students' weak literacy skills, and limited time for lessons. Similar concerns were expressed by the students, such as the difficulty in maintaining group cohesion during random groupings. Some students struggle to contribute, often staying quiet without fully engaging, though the teacher offers support to guide them. Additionally, students feel that time passes too quickly during lessons (Fariz Kafa Fahreza, personal communication, September 7, 2023). From the interviews with both teachers and students, it is evident that these obstacles hinder the optimal application of the PBL model. However, the researchers also gathered insights on the benefits of this model. Mathematics teacher M. Badrul Munir highlighted that the PBL model has introduced a fresh approach to teaching, particularly in mathematics. He noted that students are more enthusiastic about working in groups, collaborating to solve problems, and gradually improving their understanding despite initial difficulties (personal communication, September 7, 2023).

Students shared similar sentiments, with Azkia Aulia Zulfa explaining that group work allows them to discuss and solve problems together. If some students do not understand, those who do will

help explain, and the teacher often provides further clarification (personal communication, September 7, 2023). This collaborative aspect of PBL fosters a supportive learning environment where students can engage more deeply with the material. In addition, M. Badrul Munir emphasized the teacher's role as both facilitator and motivator in the PBL model. Teachers guide students through problem-solving, especially when it relates to real-life situations, while also encouraging them to be independent and active learners. This approach helps students feel comfortable exploring and understanding the material, making learning more relevant to their daily lives (personal communication, September 7, 2023). Overall, both teachers and students recognize the advantages of the PBL model in mathematics at MI Darussa'adah Domasan. These include fostering critical thinking skills, teaching students effective problem-solving methods, encouraging teamwork and respect for group members' opinions, and allowing teachers to act as facilitators. Additionally, students can apply the skills and knowledge gained through PBL to real-life situations, enhancing the relevance and practicality of their education.

Discussion

Stages of the Applications of the *Problem Based Learning Model* (PBL) in Mathematics Subjects at Madrasah Ibtidaiyah

The mathematics teachers at MI Darussa'adah Domasan, Kalidawir District, Tulungagung Regency, have systematically implemented the Problem-Based Learning (PBL) model following Arends' stages. These include introducing a problem, organizing learning activities, guiding investigations, presenting work, and evaluating the problem-solving process (Erik, 2018). This structured approach helps students develop key skills like problem-solving, collaboration, and critical thinking. Research supports the effectiveness of PBL. Zainal's (2022) study shows that PBL enhances students' higher-order thinking by encouraging real-world problem-solving, making learning more meaningful. Hotimah's (2020) research highlights PBL's impact on improving communication and critical thinking through storytelling tasks. Both studies underline how PBL engages students as active participants, promoting deeper understanding, independence, and collaboration. The PBL model proves to be a powerful and effective approach for teaching mathematics at the elementary level, fostering both academic and personal development.

The implementation of the Problem-Based Learning (PBL) model in mathematics at MI Darussa'adah is further validated by a 2019 study conducted by Liska Ariani et al. This study examined the impact of PBL in STEM (Science, Technology, Engineering, and Mathematics) subjects, focusing specifically on students' creative thinking skills. The findings from the research indicated a significant improvement in students' ability to think creatively when the PBL model was applied. One of the key aspects highlighted by the study was that students demonstrated a strong capacity to view problems from multiple perspectives, a crucial component of creative thinking. This ability to analyze and approach problems in various ways is essential not only in mathematics but also across other disciplines within STEM education. The study revealed that the PBL model encouraged students to engage more deeply with the material, leading to a more thorough understanding and innovative problem-solving techniques. Moreover, the research emphasized that students responded positively to PBL-based learning (Almulla, 2020; Amin et al., 2020; Saputro et al., 2020). This model of learning made the process more interactive and enjoyable, as students were actively involved in the learning experience rather than passively receiving information. The hands-on, problem-solving nature of PBL allowed students to apply their knowledge in real-world contexts, which contributed to higher engagement and motivation levels. As a result, students not only developed creative thinking skills but also displayed a more positive attitude towards learning STEM subjects, highlighting the effectiveness of the PBL approach in fostering both intellectual and emotional growth in students (Kim & Hannafin, 2011; Raes et al., 2012; Farrokhnia et al., 2022).

The implementation of the Problem-Based Learning (PBL) model at MI Darussa'adah Domasan begins by introducing students to a problem designed to stimulate their critical thinking and engagement. Teachers set clear learning objectives, explaining the materials and tools that will be required for problem-solving. The sequence of activities is carefully communicated to ensure students

understand the process, and the lesson is initiated with a greeting and prayer to create a respectful and positive learning environment (Orr et al., 2022; Ginting & Simamora, 2023). Following this, teachers review prior material, helping students make connections between previous lessons and the new problem they are about to solve. This review helps set the stage for the learning objectives and the problem that needs to be tackled. To promote collaboration, students are organized into groups, which are formed randomly to include students with varying mathematical abilities. This grouping strategy ensures that students can complement each other, with stronger students assisting those who may need more support. Each group is given worksheets featuring real-world, problem-based questions that encourage the application of mathematical concepts to everyday scenarios. Throughout the activity, teachers monitor the groups, guiding discussions and ensuring that all students actively participate in solving the problems together. This collaborative effort allows students to learn from each other while engaging deeply with the material.

In the third stage of implementing the Problem-Based Learning (PBL) model at MI Darussa'adah Domasan, teachers encourage both individual and group investigations. This phase is critical, as it prompts students to actively seek out information and collaborate on solutions to the problem they are working on. Teachers play a pivotal role here by monitoring the group discussions closely, observing which students are actively participating, and assessing their understanding of the material. By paying attention to the dynamics of the group, the teacher can identify students who may need additional support or guidance and tailor their interventions accordingly. This individualized attention helps ensure that every student is fully engaged in the learning process and contributes to their group's efforts. The fourth stage focuses on developing and presenting the students' work. Once the problem-solving process is complete, teachers guide students in preparing reports that summarize their approach and the solutions they devised. These reports may take various forms, such as written documentation, presentations, or even recorded videos, depending on the task at hand and the resources available (Abraham, 2018; Ariffin, 2021). After the reports are prepared, students are randomly selected from each group to present their work. These presentations can be delivered either in front of the entire class or within their own group circles, depending on the structure of the activity. This stage not only allows students to demonstrate their problem-solving skills but also helps them develop communication and presentation abilities. It encourages accountability and ensures that all group members are involved in the learning process.

In the final stage of the Problem-Based Learning (PBL) model at MI Darussa'adah Domasan, the teacher guides students through a reflection on the problem-solving process. This reflection is a crucial component, as it allows students to assess their performance, think critically about the strategies they used, and identify areas for improvement. Through this reflective process, students are encouraged to consider what they learned, how they collaborated with their peers, and how effectively they solved the problem. This stage also provides an opportunity for teachers to gather feedback on the students' understanding and the overall effectiveness of the learning activities. The teacher uses this reflection to inform decisions about future lessons, identifying which aspects of the learning model worked well and where adjustments might be needed. After reflection, the teacher summarizes the key points from the lesson, reinforcing important concepts and ensuring that students have a clear understanding of the material covered (Smyth, 1993; Ananga, 2021; Suphasri & Chinokul, 2021). Assessments are then conducted, either through the collection of students' work or through other evaluative measures such as quizzes or verbal feedback. The teacher collects the reports or worksheets produced by each group, providing an opportunity to review and assess each student's contribution to the task. This step ensures that all student work is accounted for and evaluated. To close the lesson, the teacher leads a final reflection on the day's learning, which helps reinforce the students' insights. A brief reminder about the upcoming lesson keeps students focused on what comes next. The session concludes with a closing prayer, fostering a respectful and peaceful atmosphere, followed by a farewell greeting to end the class on a positive and formal note (Machost & Stains, 2023). This structured closure not only brings a sense of completion to the learning process but also helps maintain a routine that students can rely on.

Constraints or Obstacles to the Application of the *Problem Based Learning* Model (PBL) in Mathematics Subjects at Madrasah Ibtidaiyah

The success of implementing the Problem-Based Learning (PBL) model in mathematics at MI Darussa'adah Domasan, Kalidawir District, Tulungagung Regency is influenced by several key factors, particularly the readiness of teachers in conducting learning activities and the active participation of students. However, in practice, the application of the PBL model in mathematics has faced several significant challenges. This aligns with previous research conducted by Mulyadi and Ratnaningsih (2015), which analyzed the achievements and obstacles in implementing PBL. Their research found that while PBL can be effective when properly planned and executed, it requires well-prepared learning tools, thoughtful planning, and sufficient time for optimal results.

Here are some of the specific obstacles encountered in applying the PBL model at MI Darussa'adah:

Lack of Learning Resources

One of the primary challenges is the shortage of adequate learning resources. In the context of PBL, learning resources include not only textbooks but also media, objects, data, facts, and creative ideas that can facilitate effective teaching and learning activities. At MI Darussa'adah, teachers have reported a lack of sufficient learning media, often relying on manual methods such as distributing paper worksheets. While these traditional methods are useful, they limit the dynamic engagement that PBL requires. Teachers have also expressed challenges in generating creative, real-life problems that can effectively stimulate students' problem-solving skills. This shortage of resources and innovative ideas directly affects the quality of the learning process, making it harder to implement PBL effectively (Weng et al., 2022; Parker et al., 2022).

Limited Literacy Skills

Another significant issue is the limited literacy skills among the students. At MI Darussa'adah, many students are relatively slow in developing literacy abilities, particularly when it comes to understanding complex texts, critically analyzing information, and effectively communicating their ideas. This lack of literacy not only affects their ability to grasp mathematical concepts but also hinders their capacity to engage in problem-solving activities that require thoughtful reading, interpretation, and response. The slow development of critical thinking and communication skills has a negative impact on the students' ability to fully participate in the Problem-Based Learning (PBL) process, which emphasizes creative and independent problem-solving. PBL requires students to understand problems deeply, analyze them from different perspectives, and generate innovative solutions. However, when students struggle with basic literacy skills such as comprehending instructions, explaining concepts, or clearly presenting their solutions, their potential to benefit from problem-based learning is greatly diminished. As a result, students with slow literacy development often face challenges in following the flow of PBL, which is designed to enhance higher-order thinking skills (Yew & Goh, 2016; Suyatman et al., 2021; Thornhill-Miller et al., 2023). This reduces the effectiveness of PBL in fostering students' creativity and problem-solving abilities. Addressing these literacy limitations requires targeted interventions, such as intensive reading programs and structured communication exercises, to ensure that students can fully engage in a learning process that demands independence and creativity.

Limited Time

Time constraints are another major obstacle to the successful implementation of the PBL model. The stages involved in PBL—problem identification, investigation, collaboration, presentation, and evaluation—require ample time to be carried out effectively. However, the limited time allocated for each teaching session at MI Darussa'adah often forces teachers to rush through the stages, which can result in a less thorough exploration of the problem and a superficial understanding of the material. For PBL to be successful, students need sufficient time to think critically, discuss solutions with their peers, and reflect on their learning. Unfortunately, the current time limitations can lead to hurried problem-solving processes, reducing the depth of learning and engagement. Teachers are also pressured to complete all the necessary stages in a shortened time frame, which can compromise the quality of instruction and student outcomes (Sianipar, 2019; Tabroni et al., 2022; Suhardi & Zinnurain, 2022). In

conclusion, while the PBL model has the potential to enhance students' problem-solving abilities and engage them in meaningful learning experiences, its success at MI Darussa'adah has been hindered by a lack of resources, limited student literacy skills, and time constraints. Addressing these obstacles would require the provision of better learning materials, targeted interventions to improve student literacy, and adjustments to the instructional schedule to allow for more in-depth exploration of problems (Malia & Tabroni, 2021; Nurisfah et al., 2022).

Benefits of the Applications of the *Problem Based Learning Model* (PBL) in Mathematics Subjects at Madrasah Ibtidaiyah

In accordance with the findings regarding the implementation challenges of the Problem-Based Learning (PBL) model in mathematics at MI Darussa'adah Domasan, Kalidawir District, Tulungagung Regency, there are several notable benefits that significantly improve the quality and effectiveness of the learning process. These benefits not only enrich student engagement but also provide a strong foundation for developing essential skills in both academic and practical contexts. Below is a detailed explanation of these benefits:

Improved Problem-Solving Skills

One of the key benefits of the Problem-Based Learning (PBL) model is its ability to enhance students' problem-solving skills. By engaging with real-world problems in mathematics, students are encouraged to think critically and explore various solutions. This approach promotes deeper understanding as students actively analyze and solve practical scenarios, moving beyond mere memorization of formulas. PBL also fosters collaboration, as students work in groups, sharing ideas and learning from each other's perspectives (Badraeni et al., 2020; Caroni & Nikoulina, 2021). This interaction enhances critical thinking and communication skills. Additionally, PBL encourages self-motivation and initiative, making students more independent learners who take ownership of their learning process. The collaborative nature of PBL strengthens interpersonal relationships, as students develop teamwork and communication skills, which are essential for problem-solving both in academic and real-life contexts. In summary, PBL improves students' problem-solving abilities by promoting critical thinking, collaboration, and independence in learning.

Enhanced Retention of Learning Materials

Another notable advantage of the Problem-Based Learning (PBL) model is its capacity to enhance students' retention of learning materials. Unlike traditional learning methods that often rely on rote memorization, PBL requires students to actively engage with the subject matter. This active involvement encourages a deeper understanding of the concepts being taught, as students are directly involved in exploring, analyzing, and applying the information. In PBL, students are not simply passive recipients of facts; they are encouraged to actively participate in the learning process. This hands-on approach shifts the focus from memorizing isolated pieces of information to truly understanding how concepts fit together and apply to real-world scenarios (Hmelo-Silver, 2004). As students work through problems, they are required to use critical thinking to connect the material to practical situations, which reinforces their comprehension and aids long-term retention.

By deeply engaging with the content, students develop higher-order thinking skills such as analysis, synthesis, and evaluation. These skills enable them to go beyond surface-level learning, as they are motivated to explore the material in greater depth. This process not only increases their interest in the subject matter, particularly in areas like mathematics, but also sparks curiosity in other subjects, making the learning experience more holistic. Additionally, PBL encourages students to see the relevance of what they are learning to their everyday lives (Chin & Osborne, 2008; Darling-Hammond et al., 2019). When students understand how mathematical concepts or other academic subjects can be applied to real-life problems, they are more likely to internalize the information. This relevance helps students remember and recall the material when needed, as the learning is tied to meaningful and practical experiences rather than abstract facts. In conclusion, the PBL model improves students' retention of learning materials by engaging them in active, hands-on learning. This approach helps students focus on understanding concepts in depth, develop critical thinking skills, and apply what they have learned in real-world contexts. As a result, students are better equipped to

remember and use the knowledge they have gained.

Meaningful Learning Experiences

Problem-Based Learning (PBL) fosters meaningful learning by enabling students to apply their knowledge to real-world situations. Unlike traditional learning methods that focus on abstract concepts and theoretical knowledge, PBL requires students to take what they have learned and use it in practical, real-life contexts. This approach not only reinforces their understanding of the material but also deepens their comprehension. When students engage in problem-solving through PBL, they are compelled to rely on both prior knowledge and new information to arrive at appropriate solutions. This dynamic process encourages students to actively reflect on what they already know and integrate new insights as needed. By doing so, they gain a clearer understanding of how theoretical concepts, such as mathematical principles, can be applied beyond the classroom. This real-world connection is crucial in helping students see the relevance of their learning and how it can be used in everyday situations (Getie & Popescu, 2020; Harackiewicz et al., 2016).

Additionally, the process of applying knowledge to real-world problems challenges students to think critically and holistically about the issues at hand. They are required to analyze the problem from multiple perspectives, develop strategies to solve it, and assess the effectiveness of their solutions. This not only strengthens their problem-solving abilities but also enhances their capacity for critical thinking and decision-making. As a result, students are able to approach complex situations with greater confidence and skill. By engaging students in practical applications of their learning, PBL makes the educational experience more meaningful and impactful. When students work through real-world challenges, the knowledge they acquire is not just theoretical; it becomes a tool they can use in their daily lives (Bierman et al., 2008; Yeager et al., 2016; Schot et al., 2019). This hands-on experience makes the material more memorable because students have actively engaged with it, rather than passively absorbing information. Moreover, because students have applied the knowledge in meaningful ways, the likelihood of long-term retention is significantly increased. Learning that is tied to practical experiences tends to stick with students longer because it is not only understood but also experienced. The more students are involved in applying concepts to real-world problems, the more deeply they understand the material, making it more likely that they will retain this knowledge and be able to use it in the future.

Development of Practical Skills and Independence

In addition to academic benefits, Problem-Based Learning (PBL) enhances students' skills that are highly relevant to the practical world, such as creativity, innovation, and self-directed learning. This model encourages students to think beyond conventional solutions and explore new ideas, pushing them to be more innovative when faced with challenges. In a PBL environment, students are not simply given answers; instead, they are encouraged to approach problems in creative ways, which fosters a mindset of innovation and adaptability (Aslan et al., 2020; Abdurrahman & Mahmudah, 2023). This is particularly important in preparing students for real-world scenarios, where problems often require unconventional solutions and the ability to think outside the box. One of the core strengths of PBL is that it supports the development of self-directed learning. Over time, students become more independent as they learn to manage their own learning processes. Rather than relying solely on the teacher for answers or guidance, students are encouraged to take initiative, seek out information, and evaluate different approaches to solving problems. This shift towards independence is crucial for their long-term growth, as it empowers them to take responsibility for their education and equips them with the tools to navigate future challenges on their own.

Although fostering independence takes time, the collaborative nature of PBL helps students gradually build these skills in a supportive environment. Working in groups, students learn to balance independence with teamwork, a crucial skill in both academic and professional settings. In these group settings, they have opportunities to share ideas, engage in critical discussions, and solve complex problems together. Collaboration exposes students to diverse perspectives, allowing them to refine their own ideas and approaches through peer feedback and shared experiences. This collective problem-solving experience helps students develop interpersonal skills, such as communication and

collaboration, which are essential for real-life challenges. Additionally, group work in PBL serves as a platform for practicing real-life problem-solving. By working through authentic problems that resemble challenges they might face outside of school, students are better prepared to handle similar situations in the future. They learn how to break down complex issues, evaluate potential solutions, and collaborate with others to achieve a common goal. The ability to work effectively in teams and to navigate group dynamics is a critical skill for the workplace, where collaboration is often required to solve multifaceted problems.

Leadership and Teamwork Development

Problem-Based Learning (PBL) plays a pivotal role in fostering both leadership and teamwork skills among students. The collaborative framework of PBL inherently requires students to work together, share responsibilities, and equally contribute to the group's success. This structure ensures that each student plays an active role in solving the given problems, promoting a sense of accountability and cooperation that is essential for effective teamwork. In PBL, students must take on different roles within their groups, which is crucial for developing leadership qualities. Some students naturally step into leadership positions, guiding their peers through various stages of problem-solving, from brainstorming ideas to organizing the group's approach to the problem. These leadership roles offer valuable experiences where students learn how to motivate their peers, delegate tasks, and ensure that the group stays focused on achieving its objectives (Srikan et al., 2021; Hasanah et al., 2023). This aspect of PBL encourages students to take ownership of both their individual and group efforts, fostering skills such as decision-making, conflict resolution, and managing group dynamics—skills that are critical for leadership in real-life situations.

Beyond leadership, teamwork is integral to the PBL approach. Students are encouraged to collaborate, which requires them to communicate effectively, listen to diverse perspectives, and work towards a common goal. The success of the group relies on each member's contributions, so students learn to respect the strengths and ideas of their peers (Kutnick & Berdondini, 2009; Chiriac, 2014). This collaboration enhances their ability to function as part of a team, preparing them for future environments, whether in academia or the workforce, where teamwork is essential. PBL also pushes students to take responsibility for their own learning. They are tasked with finding solutions to complex problems, often requiring them to research independently or with their group. The responsibility of presenting their findings to their peers or the class encourages a deeper engagement with the material, as students must understand it well enough to explain it to others. This process nurtures self-directed learning, where students actively seek out knowledge and take control of their educational journey (Ghani et al., 2021). This level of independence is key in building confidence in their ability to tackle challenges both in school and beyond.

Another significant aspect of PBL is the shared responsibility it creates within the group. Not only do students work together to solve problems, but they are also encouraged to assess the results of their efforts and reflect on their learning process. This self-evaluation is a critical skill that allows students to analyze both their outcomes and the methods they used to achieve them. By assessing what worked and what didn't, students develop a deeper understanding of their strengths and areas for improvement. This reflective practice ensures that students are not only focused on the end result but also on the process, helping them to refine their problem-solving and collaborative skills for future tasks. As a result of this collaborative and reflective process, students become more responsible and accountable. They learn to take ownership of their actions, understanding that their contributions directly affect the group's success (Singh et al., 2020; Zarestky et al., 2022). This accountability fosters a sense of maturity and prepares students to face the challenges of everyday life. By practicing leadership, teamwork, and self-assessment in the PBL environment, students develop the skills necessary to handle real-world problems with confidence and a sense of responsibility.

In summary, the Problem-Based Learning (PBL) model offers several key benefits that contribute to a more dynamic and effective learning experience in mathematics at MI Darussa'adah. These benefits include enhanced problem-solving skills, improved retention of learning material, meaningful learning experiences, the development of practical skills and independence, and the

promotion of leadership and teamwork. Through PBL, students are better equipped to apply their knowledge in real-life situations, making them more capable and confident learners.

CONCLUSIONS

Mathematics teachers at MI Darussa'adah Domasan, Kalidawir District, Tulungagung Regency, have implemented a problem-based learning (PBL) model in a structured manner following Arends' framework, which includes introducing problems, organizing learning activities, guiding investigations, developing presentations, and evaluating problem-solving processes. Challenges faced during implementation include limited learning resources, low student literacy skills, and time constraints. However, the benefits include improved problem-solving skills, better retention of material, enhanced understanding, development of practical and independent learning skills, and improved leadership and teamwork. Future research could focus on developing more relevant PBL models for mathematics to address these obstacles.

The implementation of the Problem-Based Learning (PBL) model at MI Darussa'adah Domasan highlights both theoretical and practical implications. Theoretically, it supports constructivist learning theories by enhancing critical thinking and problem-solving through Arends' framework, but challenges like limited resources, low literacy, and time constraints suggest the need for adaptable PBL models in diverse contexts. Practically, while PBL improves problem-solving and leadership skills, success depends on addressing these challenges. Schools should focus on improving resources, literacy support, and teacher training to manage PBL effectively, with tailored models suited for specific educational environments.

For future research, it is recommended to explore resource-rich PBL models that integrate technology to address limited learning resources and improve engagement in under-resourced environments. Additionally, studies could focus on enhancing literacy within the PBL framework, combining literacy-building activities with problem-solving tasks. Investigating effective time management strategies for PBL is also crucial, especially in schools with limited class time. Tailoring PBL models to specific educational contexts, such as rural or resource-constrained schools, would provide insights into adapting the approach. Finally, longitudinal studies on the long-term impact of PBL on academic performance and real-life application of knowledge would deepen understanding of its sustained effects.

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