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REFRAMING MATHEMATICAL PEDAGOGY: A PROBLEM-BASED LEARNING APPROACH TO CULTIVATING ACTIVE ENGAGEMENT AMONG MADRASAH IBTIDAIYAH LEARNERS

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ABSTRACT
Contemporary education seeks to cultivate in students a repertoire of essential competencies, including problem-solving, collaboration, critical thinking, creativity, and effective communication. In this context, it is imperative that educators adopt pedagogical strategies that actively engage learners in the construction of knowledge. Problem-Based Learning (PBL) has emerged as a pedagogical approach capable of fostering active learner participation while simultaneously enhancing problem-solving and critical thinking abilities. This study examines the effectiveness and contextual suitability of PBL in mathematics instruction as a means of promoting active student engagement. The research was conducted at a State Islamic Elementary School (Madrasah Ibtidaiyah Negeri) in Bantul District, Yogyakarta, involving a cohort of 30 fifth-grade students and their classroom teacher. Employing a qualitative methodology within a case study framework, the investigation drew upon multiple sources of evidence, including interviews, classroom observations, documentary analysis, and visual records. Data were processed using an interactive analytical model encompassing data condensation, data display, and conclusion drawing. Findings indicate that the integration of PBL into mathematics teaching substantively enhances students' active participation in the learning process. Moreover, PBL constitutes an effective pedagogical vehicle for advancing the objectives of Indonesia's independent curriculum within the context of elementary madrasahs.

Keywords: Active Participation; Madrasah Ibtidaiyah; Mathematics; Problem-Based Learning

ABSTRAK
Pendidikan kontemporer bertujuan untuk mengembangkan pada diri peserta didik seperangkat kompetensi esensial, meliputi kemampuan pemecahan masalah, kolaborasi, berpikir kritis, kreativitas, serta komunikasi yang efektif. Dalam kerangka tersebut, sangat penting bagi pendidik untuk menerapkan strategi pedagogis yang secara aktif melibatkan peserta didik dalam proses konstruksi pengetahuan. Problem-Based Learning (PBL) atau pembelajaran berbasis masalah muncul sebagai salah satu pendekatan pedagogis yang mampu mendorong partisipasi aktif peserta didik sekaligus mengembangkan keterampilan pemecahan masalah dan berpikir kritis. Penelitian ini mengkaji efektivitas dan kesesuaian kontekstual penerapan PBL dalam pembelajaran matematika sebagai sarana untuk meningkatkan keterlibatan aktif peserta didik. Penelitian dilakukan di salah satu Madrasah Ibtidaiyah Negeri di Kabupaten Bantul, Yogyakarta, dengan subjek penelitian terdiri atas seorang guru dan 30 siswa kelas V. Metode penelitian menggunakan pendekatan kualitatif dengan desain studi kasus, memanfaatkan berbagai sumber data seperti wawancara, observasi kelas, analisis dokumen, dan sumber visual. Data dianalisis menggunakan model analisis interaktif yang meliputi kondensasi data, penyajian data, dan penarikan kesimpulan. Hasil penelitian menunjukkan bahwa integrasi PBL dalam pembelajaran matematika secara substansial meningkatkan partisipasi aktif siswa dalam proses belajar. Lebih jauh lagi, PBL terbukti menjadi wahana pedagogis yang efektif dalam mendukung implementasi Kurikulum Merdeka di lingkungan madrasah ibtidaiyah.

Kata Kunci: *Partisipasi Aktif; Madrasah Ibtidaiyah; Matematika; Pembelajaran Berbasis Masalah*

INTRODUCTION

Learning constitutes a fundamental pillar of education, serving as the primary medium through which knowledge, skills, and values are cultivated (Kaharuddin & Hajeniati, 2020). In order to foster meaningful engagement, classroom instruction should be designed to be joyful, stimulating, and inspiring (Kened & Helsa, 2020). However, conventional teacher-centered pedagogies—where the teacher remains the dominant source of information—often provide limited opportunities for students to take an active role in their own learning (Bahar et al., 2020). In practice, such approaches frequently begin with a didactic explanation of concepts, followed by worked examples and routine exercises assigned to students (Mahmuzah, 2015). While this structure may convey content efficiently, it often underutilizes students' capacity for independent exploration and deeper cognitive engagement.

Active participation in the learning process is not merely a desirable enhancement; it is essential for cultivating curiosity, motivation, and a sense of ownership over learning outcomes (Kasi, 2022). Engagement through varied learning experiences and interactive pedagogical exchanges supports the development of students' skills, creativity, and autonomy (Yaningsi et al., 2022). Such participation enables learners to explore concepts in depth—through questioning, discussion, application, and reflection—thereby fostering more progressive and enduring understanding (Kasi, 2022). In genuinely student-centered learning environments, learners are not passive recipients of information but active co-constructors of knowledge (Sukmanasa et al., 2019; Paulo & Lucas, 2022). To achieve this, instructional steps must be intentionally designed to encourage sustained active involvement (Sukmanasa et al., 2019).

Mathematics, as a compulsory subject from elementary through tertiary education, plays a critical role in equipping students with problem-solving competencies applicable to daily life (Ahmad et al., 2023). Effective mathematics instruction should not only convey abstract concepts but also allow students to experience their practical relevance and construct understanding through hands-on activities. Within the *madrasah ibtidaiyah* context, mathematics education serves as a foundational stage for shaping cognitive abilities, attitudes, dispositions, and the grasp of basic mathematical concepts (Destiara et al., 2023; Amaliyah, 2020). This demands that teachers assume multifaceted roles—not only as content deliverers, but as facilitators of environments conducive to active, inquiry-driven learning (Lie & Triposa, 2021), supported by robust lesson design (Lumpkin, 2020) and engaging pedagogical strategies (Yuanita et al., 2018).

Despite these imperatives, the reality of mathematics instruction in *madrasah ibtidaiyah* often falls short of these ideals. A significant number of teachers continue to employ conventional methods, resulting in monotonous lessons that fail to capture students' interest (Kurino, 2020). Consequently, learners often remain passive, with their mathematical knowledge confined to what is explicitly presented by the teacher. As Widayanti and Nur'aini (2020) note, such instruction typically revolves around lecturing, questioning, and assigning practice problems—approaches that, while structured, may not sustain engagement. Compounding this challenge, negative student perceptions of mathematics—as difficult, uninteresting, or even intimidating—can diminish motivation and willingness to participate (Jannah et al., 2021;

Siregar, 2019). These attitudes, particularly among less proficient students, often result in reduced classroom participation and hinder the cultivation of mathematical competence (Pedersen & Haavold, 2023).

Interviews with fifth-grade teachers at the research site revealed that, although the current curriculum emphasizes active participation, many students still approach mathematics with reluctance. They frequently struggle with problem-solving, particularly in tackling descriptive or word problems, and hesitate to present answers publicly for fear of making mistakes and being ridiculed by peers. Such factors significantly undermine their engagement. In response, teachers have sought to create learning environments that promote active participation, one such strategy being the adoption of Problem-Based Learning (PBL), which is intended to motivate students through problem-solving as the central learning activity (Kelas, 2024).

PBL is inherently student-centered, using real or simulated problems as the initial stimulus for learning (Kurino, 2020). Its primary objective is to strengthen problem-solving abilities, not only by guiding students toward correct answers but also by encouraging them to explore alternative solutions, reflect critically on their reasoning, and develop creative approaches (Anggiana, 2019). The application of PBL in mathematics within *madrasah ibtidaiyah* thus represents an innovative pedagogical intervention, with potential benefits extending beyond problem-solving to include improvements in learning outcomes, critical thinking, motivation, and conceptual understanding (Pradnyana & Marhaeni, 2021; Meilasari et al., 2020).

Previous studies on PBL have predominantly focused on specific domains, such as enhancing learning outcomes in sequences and series, deepening conceptual comprehension, fostering mathematical problem-solving skills, and improving overall achievement in classroom settings (Wildaniati & Santoso, 2024). While this body of research aligns with the principles of the "McMaster Philosophy" introduced by Neufeld and Barrows in 1974, where problem-based inquiry forms the core of learning, it is important to note that the present study situates PBL specifically within the cultural and curricular context of Indonesian *madrasah ibtidaiyah*.

Globally, scholarly interest in PBL has expanded considerably, reaching a peak in 2020 with 1,430 publications indexed at the international level. This momentum underscores PBL's relevance as a strategy for cultivating active learning, particularly in mathematics education. Against this backdrop, the present study seeks to explore how PBL can be effectively implemented to optimize active student participation in mathematics at the *madrasah ibtidaiyah* level. The findings are expected to provide practical and theoretical contributions toward enhancing the quality of mathematics instruction in both *madrasah ibtidaiyah* and elementary schools, making learning more interactive, contextual, and participatory.

RESEARCH METHOD

This study employed a qualitative research approach with a case study design, enabling an in-depth exploration of a particular object, phenomenon, or social setting through narrative description (Anggito & Setiawan, 2018). Such an approach prioritizes the "why" and "how" of the research problem rather than focusing solely on quantitative measurement (Iswandi et al., 2023). Within this framework, the present investigation examined the implementation of a Problem-Based Learning (PBL) model as a pedagogical strategy for fostering active student participation in mathematics instruction, specifically within the *madrasah*

ibtidaiyah (Islamic elementary school) context.

The research process encompassed several critical stages, including the formulation of guiding questions, the execution of data collection procedures, the gathering of empirical evidence from participants, inductive data analysis, and the interpretation of findings (Creswell & Creswell, 2017). The study was conducted during the second semester of the 2023/2024 academic year at a State Islamic Elementary School (*Madrasah Ibtidaiyah Negeri*, MIN) in Bantul Regency, Yogyakarta. The research subjects comprised 30 fifth-grade students—17 male and 13 female—selected through purposive sampling. This technique was employed on the basis that fifth-grade students possess sufficient cognitive maturity to analyse issues in mathematics learning.

The informants in this study included the school principal, the fifth-grade classroom teacher, and selected students from the same grade level. A summary of the research informants is presented in Table 1.

Table 1. Research Informant Data

Informant	Gender	Position
Robichun	Male	Principal
Sofuah	Female	Fifth-Grade Teacher
Fahim	Male	Fift-Grade Student
Royan	Male	Fift-Grade Student
Najwa	Female	Fift-Grade Student

Data were obtained from multiple sources of evidence, including interviews, classroom observations, documentation, field notes, written records, and other visual materials. Once collected, the data were analysed using an interactive model of qualitative data analysis (Miles et al., 2014; Cahyono, 2021), which involves three cyclical stages: data condensation, data display, and conclusion drawing/verification. The process is illustrated in Figure 1.

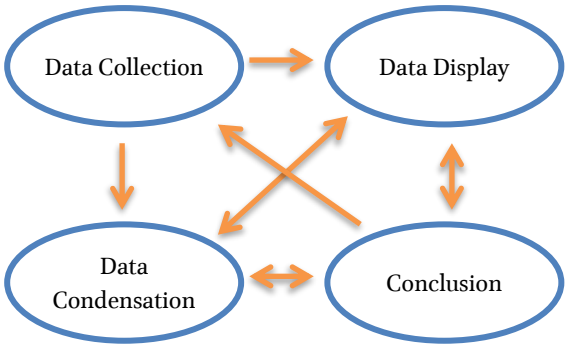

Figure 1. Interactive Model of Data Analysis

As shown in Figure 1, the interactive analysis process begins once the requisite data have been gathered. This iterative procedure consists of reducing and refining the data (data condensation), organising and presenting the findings in a coherent form (data display), and, ultimately, deriving conclusions and verifying their validity. To ensure the credibility and trustworthiness of the data, triangulation was employed by comparing information obtained from different sources—specifically, interviews, observations, and supplementary documents.

The assessment of students' active participation in the PBL context was guided by six modified indicators of learning activity adapted from Rahmaniar and Prastowo (2021). These served as the operational criteria during observation and included: 1) Student engagement in completing tasks assigned by the teacher; 2) The frequency and quality of questions posed to the teacher or peers; 3) Active participation in group discussions; 4) Demonstrated problem-solving skills; 5) The ability to seek and utilise information for solving problems; and 6) The capacity for self-evaluation of learning outcomes.

RESULTS

Interviews with the informant (R2) revealed that, in implementing Problem-Based Learning (PBL), the teacher consistently selects problem contexts that are accessible and comprehensible to students prior to instruction. This preparatory step is

intended to ensure that the problems presented are capable of stimulating student engagement, thereby facilitating productive discussions and promoting participation across the entire class. As the teacher explained:

"For all lessons, I follow the same planning process as usual; however, when implementing problem-based learning, I must first prepare a problem context that helps students understand and stimulates effective discussion. This is because, when I present problems in the form of descriptive or story-based questions, students sometimes still struggle to translate them into mathematical statements." (Observation, 2024)

The teacher further noted that crafting problem contexts which are relevant and appropriately challenging is essential, as these serve as the catalyst for meaningful peer interaction and collaborative inquiry. In practice, the selection of such problems is guided by their potential to generate collective participation rather than limiting engagement to a small subset of students.

The interviews also highlighted the perceived impact of PBL on fostering active student participation in mathematics learning. The teacher acknowledged that implementing PBL in the classroom presents certain challenges; however, by positioning students as the central agents in the learning process, PBL significantly enhances their involvement. As stated by the informant:

"The implementation of problem-based learning in mathematics classes is not easy, but problem-based learning that makes students the main component of learning certainly encourages them to participate more and be actively involved in the learning process—from asking questions, discussing, and completing the tasks I assign, to engaging in problem solving and participating during the assessment or evaluation of their learning outcomes." (Observation, 2024)

From the teacher's perspective, the integration of PBL not only improves student participation but also creates a more enjoyable and interactive learning environment. This dual outcome—enhanced engagement and positive learning experiences—was consistently emphasised as a central benefit of the approach.

DISCUSSION

Implementation of Problem-Based Learning in Mathematics

Integrating pedagogical models into classroom practice is seldom as straightforward as theoretical frameworks might suggest. Teachers are not only facilitators but also instructional designers who must engage in meticulous planning and exert sustained effort to execute their strategies effectively. In mathematics education, the implementation of Problem-Based Learning (PBL) poses particular challenges, as it places authentic, real-world problems at the core of the learning process. In this approach, students are introduced to a meaningful problem at the very beginning of the lesson to stimulate engagement and foster active participation. Here, the students occupy the central role in the learning process, while teachers function as facilitators—providing guidance, support, and scaffolding to ensure learning progresses productively.

Findings from interviews with the informant (R2) revealed that teachers deliberately select problem contexts that are both relevant and accessible to students before instruction begins. This ensures that the intended concepts can be conveyed more effectively, thereby increasing the likelihood of achieving the desired learning objectives. Well-chosen problem contexts not only enhance comprehension but also stimulate

student involvement in collaborative learning activities. These insights align with Sarnoko et al. (2024), who emphasise that PBL begins with a problem and leverages it as a catalyst for active student engagement. Similarly, Dolmans et al. (2016) argue that the success of PBL depends on carefully crafted problems, with teachers facilitating discussions rather than dominating them.

PBL thus positions the problem context at the forefront of the instructional sequence, providing a stimulus that motivates learners to participate actively. Moreover, by adopting a student-centred orientation, the model shifts the teacher's role toward that of a tutor who offers targeted assistance when learners encounter conceptual or procedural difficulties. This alignment of structure and facilitation promotes greater student autonomy and engagement.

In the present study, the implementation of PBL in fifth-grade mathematics adhered to Barret's five-stage model, as cited in Muna and Darsono (2023):

1. Orienting students to the problem – The teacher presents problems drawn from everyday life, communicates learning objectives, clarifies logistical requirements, and motivates students to engage with selected problem-solving activities. Students prepare the necessary materials and resources to support the process.
2. Organising learning tasks – The teacher forms student groups, helping them to define and organise the scope of their inquiry to ensure the problem remains manageable.
3. Conducting investigations – Students engage in experiments, inquiries, and investigative activities to build understanding and formulate solutions.
4. Presenting findings – The teacher supports students in preparing reports, documenting results, and sharing tasks. Groups present their findings to the class, followed by peer discussion.
5. Reflecting and evaluating – The teacher guides students in reviewing their process and outcomes, assigning evaluative tasks that serve both as assessment tools and opportunities for metacognitive reflection.

This structured application of PBL produced notable improvements in students' active participation and enthusiasm during mathematics lessons. Guided and supported by the teacher, students were able to solve problems independently, ask clarifying questions without hesitation, and engage in discussions with greater confidence. Furthermore, the learning process cultivated a range of essential skills—including critical thinking, problem-solving, communication, collaboration, and creativity. The instructional design consistently placed students at the centre of the learning experience, with the teacher acting primarily as a guide and facilitator. These findings are consistent with prior research indicating that PBL, when integrated with student-centred learning (SCL) strategies, positions students as the principal agents in solving authentic problems, while teachers assume a predominantly mentoring role (Darmawan & Hidayah, 2017).

Active Student Participation in the Implementation of Problem-Based Learning

The deliberate selection of instructional models is critical for fostering student motivation and sustaining active engagement in the learning process. By creating an intellectually stimulating and enjoyable classroom atmosphere, teachers can nurture intrinsic motivation, which, in turn, enhances student commitment to learning. Achieving this requires genuine interaction—both between teachers and students and among students themselves—to cultivate a learning environment conducive

to active participation and optimal academic outcomes. Within this context, the implementation of Problem-Based Learning (PBL) in mathematics education represents a strategic, effective, and practical approach for achieving curricular objectives. By situating students at the centre of the learning experience, PBL not only enriches the learning process but also sustains engagement through authentic problem-solving activities.

Evidence from classroom observations indicated that active participation manifested at multiple stages of the learning process, including question-and-answer sessions with the teacher, collaborative discussions, task completion, and problem-solving activities. These findings align with Rahmaniar and Prastowo (2021), who argue that collaborative learning tasks and structured discussions enable students to adopt active, constructive roles in their own learning. This, in turn, fosters a dynamic classroom climate in which students can fully develop their potential.

Figure 3. Learning Process in Grade V

Figure 4. Learning Process in Grade V

Figures 3 and 4 illustrate the execution of discussion and problem-solving tasks in fifth-grade mathematics lessons using the PBL model. In these sessions, students collaborated with peers to complete tasks assigned by the teacher, engaging in purposeful dialogue aimed at resolving the problems presented. These discussions were designed not only to stimulate cognitive engagement but also to promote more productive participation, with the teacher serving as a facilitator who intervenes when students encounter difficulties or uncertainties.

PBL is inherently collaborative, involving small-group work guided by the teacher in the dual capacity of facilitator and evaluator. Students are expected to play an active role in every stage of discussion, contributing substantively to collective problem-solving efforts (Tefera et al., 2024). This pedagogical approach has the potential to transform the learning experience into one that is both engaging and enjoyable (Servant-Miklos et al., 2019; Husna et al., 2024). By initiating learning with the resolution of relevant, real-world problems, PBL supports the development of students' critical thinking abilities (Alexander et al., 2024) and offers a viable alternative to traditional lecture-based instruction (Laforce et al., 2017). Active participation, in this sense, is reflected in students' willingness to contribute, sustained attention, and readiness to learn (Kassab et al., 2023).

The results of this study corroborate the six indicators of active learning identified in prior research. First, task completion—students consistently completed assignments provided by the teacher. Second, question-asking—students actively posed questions to teachers or peers when they encountered difficulties. Third, discussion engagement—students participated actively in group discussions and collaborative tasks to address

the given problems. Fourth, problem-solving ability—students demonstrated initiative in tackling problems, often consulting with group members to refine solutions. Fifth, information-seeking skills—students sought out relevant information and clarification to resolve the problems posed. Sixth, self-evaluation of learning outcomes—students independently reviewed their problem-solving processes, compiled reports, and assessed their own progress.

In this study, the PBL model functioned as a collaborative learning framework that consistently fostered active participation across all stages of instruction. The teacher's role was not to dominate or lead the discussion in a didactic manner, but rather to provide scaffolding and guidance as needed—an approach consistent with the assertion by Zheng and Wang (2022) that teachers in PBL settings are facilitators rather than prescriptive instructors. This redefined role empowers students to take ownership of their learning while maintaining a structured environment in which meaningful collaboration can flourish.

Teachers' Challenges in Implementing Problem-Based Learning

Inevitably, teachers encounter various challenges when conducting classroom instruction. To ensure a high-quality learning process, educators must account for the diverse needs, abilities, and characteristics of their students. In mathematics education, the application of Problem-Based Learning (PBL) demands careful planning; however, in practice, the realities of classroom dynamics often deviate from the initial instructional plan. Many of these contingencies are difficult to predict in advance, requiring teachers to devise adaptive strategies to maintain lesson continuity, efficiency, and effectiveness, while still achieving the intended learning objectives.

Interviews with the informant (R2) revealed that one of the recurrent challenges in PBL is sustaining student engagement when learners struggle to understand the problem context. Although PBL is intended to foster active participation by involving all students, comprehension barriers can reverse this dynamic. As the teacher explained:

"Problem-based learning can help students actively participate in learning because I always try to involve all students. However, if students cannot or have difficulty understanding the context of the problem I present, they become passive again and feel confused about how to solve it." (Observation, 2024)

This finding is consistent with Muna and Darsono (2023), who observed that students unfamiliar with the PBL approach often experience confusion, particularly in its early stages of implementation. Nevertheless, the fifth-grade teacher in this study employed several strategies to mitigate such challenges. For example:

"If students feel confused and unable to do the task, I use the answers of their friends who have already finished, or if students do not understand, I usually ask them to come forward and do it. However, if students are afraid to come forward alone, I usually allow them to come forward with their friends." (Observation, 2024)

Beyond comprehension-related obstacles, time constraints also emerged as a notable challenge. Mathematics lessons—especially those involving PBL—sometimes ended before all students had completed the assigned tasks. Additionally, teachers reported difficulties in crafting problem scenarios that were simultaneously accessible, engaging, and conducive to discussion. As the informant elaborated:

"For problem-based learning, I sometimes find it difficult to determine and present questions

that are easy for students to understand and can stimulate discussion. For example, if the problem is presented in the form of a story problem, students sometimes struggle to understand the sentences where the story problem must first be converted into mathematical sentences, such as 'Mother bought 2 kg of rice' or if it's in the form of fractions, for example, '2 ½ kg of rice, then bought ½ kg of sugar and 1 ½ kg of eggs, how much did Mother buy?' Here, they become confused and unsure about how to formulate the mathematical sentence, often asking the teacher whether it should be added or subtracted, and so on." (Observation, 2024)

Such challenges mirror those documented by Tyas (2017), who noted the inherent difficulty in identifying problem prompts that can effectively stimulate rich classroom discussion. Moreover, as Farhana et al. (2023) emphasise, the varying levels of mathematical proficiency among students mean that some require substantially more time to process information, leading to situations where the allocated lesson time proves insufficient. This underscores the need for flexible pacing, differentiated instruction, and well-structured scaffolding to ensure that all learners can engage meaningfully with the PBL process.

CONCLUSION

The implementation of the Problem-Based Learning (PBL) model in mathematics instruction serves multiple pedagogical functions. Chief among these is its capacity to stimulate students' conceptual understanding by engaging them in the resolution of diverse problems situated within the context of mathematical content. Beyond cognitive gains, PBL enables learners to perceive and experience the practical relevance of mathematics in their everyday lives, while simultaneously providing opportunities to construct knowledge through active, participatory learning experiences.

In this study, the PBL model functioned as a collaborative learning framework that consistently fostered active student engagement, both during discussions and throughout the broader learning process. Rather than directing each stage of instruction in a didactic manner, the teacher assumed the role of facilitator—providing support, scaffolding, and strategic guidance as needed. This role repositioning aligns with the principle that, within PBL, the teacher is not a tutor who dominates discourse but a facilitator who creates the conditions for autonomous and collaborative learning to flourish.

Practically, the facilitative role was evident in both individual and group learning contexts. During independent learning activities, students were encouraged to present the outcomes of their tasks to the class, thereby enhancing ownership and accountability. In group-based tasks, students worked collaboratively to address real-world problems derived from their own daily life experiences. The teacher's responsibilities in these contexts included monitoring progress, accompanying groups during discussions, and prompting inquiry by encouraging students to ask clarifying questions when encountering conceptual difficulties.

By situating mathematical problems within authentic, lived experiences, PBL supports both comprehension and problem-solving efficacy. As demonstrated in this research, the model offers a viable and effective approach for operationalising mathematics education within the *Kurikulum Merdeka* (self-directed curriculum) framework at the elementary school level, ensuring that learning is interactive, contextually grounded, and centred on active student participation.

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