Jurnal Ilmiah Pendidikan Citra Bakti
p-ISSN 2355-5106 || e-ISSN 2620-6641
https://jurnal.citrabakti.ac.id/index.php/jil

ANALYSIS THE IMPLEMENTATION OF CONTEXTUAL BASED PROBLEM BASED LEARNING IN STRENGTHENING THE MATHEMATICAL CRITICAL THINKING OF LOWER GRADE

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Article History

Received:
January 23, 2026

Accepted:
February 2, 2026

Published:
February 15, 2026

Abstract

The stagnation of critical thinking skills in elementary school students is often rooted in the gap between abstract mathematics curricula and the cognitive characteristics of students who are still in the concrete operational stage. Conventional teacher-centered methods exacerbate this condition, rendering students passive. This study aims to analyze the implementation of the Problem-Based Learning (PBL) model using contextual problems to strengthen students' mathematical critical thinking skills. Employing a descriptive qualitative approach, the research was conducted at SDN Cemengkalang with Grade III students as subjects. Data were collected through participant observation, interviews, and documentation, then analyzed using triangulation techniques. The results demonstrate that integrating real objects (such as wall clocks and floor tiles) within PBL stages effectively bridges students' thinking from concrete to abstract phases. Specifically, the *focus* indicator improved sharply as students became capable of filtering essential data from complex narrative problems. In the *reasoning* aspect, group discussion interactions encouraged students to shift from merely providing short answers to constructing evidence-based causal explanations regarding geometric properties. Meanwhile, *inference* skills were formed through independent conclusion-drawing, which was refined through iterative reflection processes. It is concluded that PBL successfully transforms students' roles from passive receivers into active knowledge constructors. Theoretically, these findings reinforce social constructivism theory, while practically recommending visual contextual problems as the primary scaffolding in lower-grade classes.

Keywords: *Problem Based Learning*, Mathematical Critical Thinking, Contextual Problems, Elementary School

Abstrak. Stagnasi keterampilan berpikir kritis pada siswa sekolah dasar sering berakar pada kesenjangan antara kurikulum matematika yang bersifat abstrak dan karakteristik kognitif siswa yang masih berada pada tahap operasional konkret. Metode pembelajaran konvensional yang berpusat pada guru memperparah kondisi ini sehingga siswa menjadi pasif. Penelitian ini bertujuan menganalisis penerapan model *Problem-Based Learning* (PBL) melalui masalah kontekstual untuk memperkuat keterampilan berpikir kritis matematis siswa. Penelitian ini menggunakan pendekatan kualitatif deskriptif dan dilaksanakan di SDN Cemengkalang dengan subjek siswa kelas III. Data dikumpulkan melalui observasi partisipan, wawancara, dan dokumentasi, kemudian dianalisis menggunakan teknik triangulasi. Hasil penelitian menunjukkan bahwa integrasi objek nyata (seperti jam dinding dan ubin lantai) pada tahapan PBL secara efektif menjembatani proses berpikir siswa dari konkret menuju abstrak. Secara khusus, indikator fokus meningkat tajam ketika siswa mampu menyaring data yang esensial dari masalah naratif yang kompleks. Pada aspek penalaran, interaksi dalam diskusi kelompok mendorong siswa beralih dari sekadar memberikan jawaban singkat menjadi menyusun penjelasan sebab-akibat berbasis bukti terkait sifat-sifat geometri. Sementara itu, keterampilan inferensi terbentuk melalui penarikan kesimpulan secara mandiri, yang kemudian dipertajam melalui proses refleksi berulang. Disimpulkan bahwa PBL berhasil mentransformasi peran siswa dari penerima pasif menjadi pengonstruksi pengetahuan yang aktif. Secara teoretis, temuan ini memperkuat teori konstruktivisme sosial, sedangkan secara praktis merekomendasikan penggunaan masalah kontekstual visual sebagai *scaffolding* utama pada kelas rendah.

Kata kunci: *Problem-Based Learning*, berpikir kritis matematis, masalah kontekstual, sekolah dasar

Background

The paradigm of mathematics education in the 21st century has shifted from simply being able to calculate to mastering higher-level thinking skills. Mathematics does not only serve as a tool for calculation, but also as a means of training the brain to analyze and solve everyday problems logically. One crucial competency that students must master is mathematical critical thinking. This ability allows students to not simply accept information at face value, but to process it through stages of reasoning, analysis, and evaluation before making decisions (Triana, A., & Amelia, 2024). To overcome these problems, a learning model based on real-world problems is needed. Problem-Based Learning (PBL) is considered appropriate because it trains students to solve problems through scientific methods, collaboration, and independent learning. Recent studies show that PBL is effective in improving learning outcomes and collaboration skills among elementary school students (Fitria, Arianto, & Sumarno, 2024; Maryani, Riyadi, & Kurniawan, 2025). Similarly, other studies have reported an increase in academic achievement in geometry through PBL (Jenah,, Wahdah, & Syar, 2022; Nisak, 2023).

Critical thinking is a process of deep, careful thinking that involves comparing various pieces of information. Critical thinking is an important aspect of mathematical thinking that every student needs to master in order to analyze and solve various problems they encounter (Jufriadi et al., 2022). At this time, critical thinking skills are essential for life, work, and functioning effectively in all other aspects of life. Critical thinking skills are important for students to have because they can help them understand and solve story-based problems and issues related to everyday situations (Prajono et al., 2022). Critical thinking is the ability of students to solve problems and make decisions from various aspects and perspectives. For this reason, critical thinking must be practiced from elementary school (Nicomse & Girsang, 2022). Critical thinking is a thought process that involves cognitive processes such as reasoning, analyzing, and evaluating. Critical thinking is an intellectual skill that plays an important role in an individual's education and social (Fitriyah & Qibtiyah, 2021).

The ability to think critically in elementary school students is something that must be developed (Maysarah et al., 2024). Critical thinking skills equip students to observe, analyze, and evaluate information before making decisions. Therefore, these skills need to be developed from elementary school so that students have a foundation of critical thinking in completing tasks and facing everyday problems (Lestari et al., 2021). So that when they move on to higher levels such as junior high school, high school, or college, students will have no difficulty practicing their critical thinking skills. Critical thinking skills are important for students to get used to thinking deeply and being able to give logical reasons for their actions (Sari & Lutfi, 2023). The reason is that critical thinking skills are very important for improving one's ability to solve problems in everyday life (Fitriyah et al., 2021).

Mathematical critical thinking is a high-level thinking skill, making critical thinking no less important for students to master. It is not only used in dealing with problems in mathematics lessons, but also implemented in concrete problems in everyday life. (Dinda Nuraini et al., 2025). Critical thinking skills are closely related to mathematics learning because they help students understand concepts, think systematically, and solve problems. In mathematics, critical thinking allows students to apply concepts to various situations and find creative solutions, thereby not only improving academic achievement but also equipping students to deal with real-life problems (Minangkabau et al., 2024). Mathematical thinking is a mental activity in which mathematical ideas are abstracted and generalized. Because mathematics is a subject that requires greater reasoning, it requires higher-level thinking. Thus, mathematics is a widely used (Endrawati & Aini, 2022).

Initial observations in the third grade of SDN Cemengkalang showed a discrepancy between learning requirements and actual conditions in the classroom. Flat shape material, which should train students' spatial analysis skills, tended to be taught through memorization of formulas due to teacher-centered learning. In fact, mathematics learning requires critical thinking skills so that students are able to evaluate information and understand contextual problems. This condition is further reinforced by the cognitive development characteristics of third-grade students, who are in the concrete operational phase, where logical thinking skills are highly dependent on visualization and real objects that can be manipulated.

The Project-Based Learning (PBL) model is an approach that supports the achievement of 21st century educational goals by emphasizing critical thinking, communication, collaboration, and creativity skills. This model is designed based on the principle of group learning, where students build understanding through learning experiences and relate them to problems given by the teacher. The PBL approach uses problems related to daily activities as a learning framework to train critical thinking, problem-solving, and independent learning skills. During the learning process, students are actively involved in problem-solving through the scientific method stages so that they acquire relevant knowledge and problem-solving skills. The PBL model utilizes real problems that require accurate and relevant information, making it very suitable for implementation in elementary schools. PBL implementation is carried out in several stages, starting from orienting students to the problem, organizing students into groups, guiding the investigation process individually and in groups, developing and presenting the results, to analyzing and evaluating the learning process to strengthen student understanding (Novelni & Elfia Sukma, 2021).

The theory underlying the PBL model is cognitive psychology, particularly based on Piaget and Vygotsky (constructivism). The development of constructivist learning theory holds that knowledge and understanding are not acquired passively, but actively through individual experience and experimental activities. Piaget emphasized the importance of cognitive adaptation through assimilation and accommodation, while Vygotsky highlighted that optimal learning occurs in the Zone of Proximal Development (ZPD), which is the area between students' actual abilities and potential with the help of teachers or peers. (Oktaya & Panggabean, 2022). Problem-based learning is built on the ideas of constructivism and learner-centered learning approaches. The PBL model emphasizes collaboration among students in small groups with a primary focus on learner-centered learning activities. The role of the teacher is no longer as the main source of information, but rather as a facilitator who guides the learning process through the presentation of contextual problems from real life (Ngadha et al., 2024). (Prasasty et al., 2025).

A number of recent studies also show a positive trend in the use of PBL models in mathematics learning in elementary schools. Maryani found that PBL was effective in significantly improving the critical thinking skills of fourth-grade students compared to conventional methods (Maryani, Riyadi, & Kurniawan, 2025). Similar findings conclude that PBL is capable of training students to solve complex mathematical problems through group collaboration (Fitria, Arianto, & Sumarno, 2024; Harianja, Tampubolon, & Manalu, 2023). However, the majority of these studies tend to use a quantitative approach that focuses on measuring final results (pre-test and post-test scores). There is still little literature that qualitatively examines how the critical reasoning process develops step by step as students interact with contextual problems in lower grades. Therefore, this study aims to fill this gap by analyzing in depth the process of implementing PBL in strengthening students' mathematical critical thinking.

Various empirical studies have proven the effectiveness of PBL. Other studies show that PBL is effective in improving mathematics learning outcomes in flat shape material in IV grade (Nisak, 2023). Similar findings reveal a positive correlation between the implementation of PBL assisted by visual media and improvements in student academic achievement (Choir, & Reffiane, 2024; Jenah, Wahdah, & Syar, 2022). Recent research further emphasizes that PBL facilitates collaboration skills and higher-order thinking skills (HOTS) better than conventional methods (Fitria, Arianto, & Sumarno, 2024; Maryani, Riyadi,, & Kurniawan, 2025).

Research trends in basic education over the past two years show a shift in focus from mere mastery of concepts to the development of strategic competencies such as critical thinking. Recent studies also confirm that the application of the PBL model has proven to be significantly more effective in improving the critical thinking skills of elementary school students than expository methods (Darmawati, & Mustadi, 2023). This finding is reinforced by other studies that conclude that the use of PBL-based teaching materials can validate the improvement of students' critical thinking skills in a practical and effective manner (Pujiono, P., Sutiarso, S., & Dahlan, 2024). Therefore, the urgency of applying PBL in this study is not only practically relevant in the classroom, but also has a strong empirical basis from the latest literature.

Method

This study uses a qualitative approach with a descriptive type. This approach was chosen because the researcher aims to understand the phenomena experienced by the research subjects holistically and describe them in words in their natural context (Lexy J. Moleong, 2022). The main focus of the study is to systematically and factually describe how teachers implement PBL steps to foster students' mathematical critical thinking without providing manipulative treatment (Waruwu, 2024). The research was conducted at SDN Cemengkalang, Sidoarjo Regency, East Java. The research subjects consisted of third-grade teachers as the learning implementers and third-grade students as the subjects receiving the intervention. Student informants were selected using purposive sampling with the criterion of academic ability representation (high, medium, and low) to obtain comprehensive response data variation.

Data collection techniques included three main instruments. First, passive participant observation, in which researchers were present in the classroom to observe learning interactions and the emergence of critical thinking indicators without direct intervention.

Second, semi-structured interviews were conducted with teachers and students to explore in-depth information about students' constraints and responses to problem-based learning. Third, documentation in the form of photos of activities, teaching modules, and student worksheets was used as supporting evidence for the findings. Data analysis was conducted using an interactive model developed by Miles, Huberman, and Saldaña, which consists of three concurrent activities: (1) data condensation, which is the process of selecting, focusing, simplifying, and abstracting data from field notes and interview transcripts; (2) data display, which is organizing information to enable conclusions to be drawn; and (3) drawing/verifying conclusions. (Miles, M. B., Huberman, A. M., & Saldana, 2014). To ensure the validity of the data in this study, the researcher applied technical triangulation (comparing observation results with interviews) and source triangulation (comparing information from teachers and students).

Results and Discussion

Research Results

Based on the results of this study, the findings obtained from the research conducted at Cemengkalang Public Elementary School are presented. This section describes in detail the implementation of the PBL model in mathematics learning and how its application contributes to fostering mathematical critical thinking skills.

The results of the study indicate that the implementation of the PBL model in mathematics learning in class III A of Cemengkalang Public Elementary School contributes positively to the learning process and the development of students' mathematical critical thinking skills. Learning is carried out with reference to the PBL stages, namely problem orientation, student organization, investigation guidance, development and presentation of results, and analysis and evaluation of the problem-solving process. All of these stages were carried out contextually and adapted to the characteristics of elementary school students. Interviews with classroom teachers showed that the PBL stages were implemented gradually so that students could understand the learning flow well and not feel overwhelmed.

Mathematics learning conducted using the PBL mode in this study focused on flat shapes, specifically the introduction of simple flat shapes such as squares, rectangles, triangles, and circles. The material covered the characteristics of flat shapes, including the number of sides and angles, as well as the concepts of fold symmetry and rotational symmetry. The problems given to students were arranged in the form of contextual questions related to objects in the classroom environment, such as blackboards, wall clocks, and floor tiles, thereby helping students relate the concept of flat shapes to real-life experiences. Based on the interview results, the teacher said that presenting flat shape material through contextual problems made it easier for students to understand the concepts and encouraged them to be more active in the discussion and problem-solving process. This was reinforced by the teacher's statement in the interview that “children understand flat shapes more quickly when they are associated with objects they see every day in class.” The teacher also added that the use of contextual problems made it easier for students to distinguish the characteristics of each flat shape. In line with the results of the observation and interview, this is reinforced by the documentation of students showing flat shapes associated with objects they see every day in class, as shown in Figure 1.

Figure 1. Identifying the Concept of a Circle on a Contextual Object (Wall Clock) as a Problem Orientation Stage

During the orientation stage, teachers begin the lesson by presenting questions that encourage students to observe the shapes around the classroom and distinguish the characteristics of each shape. The questions are not only intended to introduce the material, but also to stimulate curiosity and encourage students to think critically about the issues at hand. Based on the results of interviews with teachers, the problem orientation stage is considered very important in PBL learning. Teachers said that “if children are interested at the beginning, they will be more enthusiastic about participating in discussions and looking for answers.” This shows that the problem orientation stage plays a role in fostering motivation and readiness to think among students.

In the early stages of learning, teachers begin activities by presenting mathematical problems that are relevant to students' daily lives, especially in the form of story problems. The diversity of student responses was clearly evident during the observation. Although the problems presented were designed to stimulate curiosity and problem-solving strategies, the reactions that emerged were not uniform. On the one hand, there was a group of students who were spontaneously able to analyze problems and propose initial arguments. However, on the other hand, there is still a group that is passive and highly dependent on teacher guidance just to understand the basic information in the question. This is reinforced by the results of teacher interviews, which state that students need to get used to understanding the question first before determining the solution, because initially students tend to want to get the answer directly.

The stage of organizing students for learning is carried out by dividing students into small groups consisting of five to six people. The teacher then distributes worksheets containing activities to identify the characteristics and properties of flat shapes, including activities of folding and rotating flat shapes to determine their fold symmetry and rotational symmetry. At this stage, students are directed to work together in groups and share roles in completing the assigned tasks. The teacher said in an interview that the purpose of dividing the students into groups is so that they can help each other. The teacher stated that "through group work, students who already understand can help their friends who are still having difficulties."

Next, the teacher organizes students into small groups to discuss the problems that have been given. Collective activities in formulating solution steps are the core of this phase. Field data reveals a dual reality: on the one hand, there is a surge in idea participation, but on the other hand, there are still a handful of students who are passive and dependent on their friends' dominance. However, these barriers to passivity are slowly being eroded. Through group work mechanisms, students who were initially silent are finally encouraged to join the discussion and contribute to solving problems. Based on interviews with students, group discussions are considered helpful in understanding the material because they can ask each other questions and share different ways of solving problems. Students said in interviews that "it's easier to understand when studying with friends, because you can ask questions when you don't understand." This shows that group discussions play a role in helping students understand mathematical concepts.

The stage of guiding individual and group investigations is carried out with the teacher acting as a facilitator who provides direction and assistance during the discussion process. The teacher asks follow-up questions to help students analyze their observations of flat shapes and draw preliminary conclusions. Students are encouraged to explain the reasons for their answers and compare the results of their discussions with other groups.

The results of interviews with third grade teachers revealed that the implementation of PBL made students more active than conventional learning. Teachers said that students did not only focus on the final answer, but began to get used to explaining the reasons and steps they used to arrive at the answer. The teacher also stated that PBL learning provides opportunities for students to learn to work together and practice the courage to express their opinions. In addition, the teacher added that through PBL, students become more courageous in asking questions when they have difficulty understanding the material.

However, the teacher acknowledged that there are still obstacles in the guidance stage of the investigation, especially in directing students to be able to think more deeply and not just imitate their friends' answers.

The stage of developing and presenting results was carried out by giving each group the opportunity to present the results of their discussions in front of the class. Presentations were made in turns using folding symmetry boards and rotational symmetry boards as tools. Through this activity, students were trained to communicate their thoughts and respond to the opinions of other groups. Students stated that “going to the front of the class was nerve-wracking, but it made us more courageous in explaining our group's answers.” This shows that the presentation stage trains students' courage and communication skills.

Findings from student interviews indicate that they are more interested in learning that begins with problems. Students stated that group learning helps them understand mathematics better because they can ask questions and discuss with friends. In addition, students find learning more enjoyable because they not only listen to the teacher's explanations but also find it easier to understand story problems when discussing them with friends in their group.

The final stage, which is analyzing and evaluating the problem-solving process, is carried out through individual formative assessments. Teachers discuss the evaluation results with students and reinforce the concept of flat shapes, particularly in relation to the characteristics of flat shapes and the differences between fold symmetry and rotational symmetry. This stage helps students reflect on the learning process they have undergone.

Based on observations and analysis during learning, students' mathematical critical thinking skills began to emerge through their ability to identify problems, select relevant information, and logically organize steps to solve problems. Students also began to be able to explain the reasons for their answers, although this was not consistent among all students. The results of teacher interviews show that these skills develop gradually as students get into the habit of discussing and solving problems. The implementation of PBL in class III A of SDN Cemengkalang supports the principles of constructivism by providing space for exploration and discussion, so that mathematics learning becomes more meaningful and easier to relate to real-life situations.

Overall, the results of the study indicate that the implementation of contextual problem-based learning (PBL) is capable of supporting the development of students' mathematical critical thinking skills. Although there are still obstacles in its implementation, particularly in optimizing the role of teachers as facilitators and increasing the active participation of all students, the PBL model continues to show strong potential for application in mathematics learning in elementary schools. Based on the interview results, teachers hope that the PBL model can continue to be implemented sustainably with improvements in time management and student assistance. With more careful planning and appropriate assistance, PBL can become an effective learning model for developing students' critical thinking skills in mathematics from the elementary school level.

An in-depth analysis of student activities and work output highlights a surge in competence in three fundamental aspects: sharpness in problem identification (focus), construction of logical arguments (reason), and the ability to formulate conclusions (inference). Empirical findings on these three indicators provide irrefutable evidence that the intervention using the PBL model in this study has successfully strengthened students' mathematical critical thinking skills significantly.

During the learning process, students are challenged to deal with contextual problems related to flat shapes in their surroundings. These problems encourage students to examine the available information, select the appropriate concepts, and determine the right solution strategy. Based on the observation results, students showed the ability to focus on the core of the problem and ignore irrelevant information. In the initial phase, the main obstacle for students was confusion when they had to untangle the web of information in the story questions. However, habituation to contextual problems through the PBL model successfully reversed this situation. The progress that occurred was very significant: students who were once passive were now transformed into reliable information filters. They were able to isolate crucial data for solutions and discard irrelevant details. This cognitive transformation was validated by teachers, who noted that information distractions no longer prevented students from grasping the essence of the problem. This means that the basic competency of critical thinking—the ability to select information in a targeted manner—has been firmly established.

The most notable improvement was seen in the reasoning indicator. Before the PBL intervention, students tended to give only brief answers without supporting arguments. After the implementation of group discussions, students began to get used to explaining why a shape was categorized as a square, rectangle, or triangle by referring to the physical characteristics they had observed. Their explanations were no longer empty claims, but were accompanied by logical reasons based on observational evidence (such as the number of sides or types of angles

This change in mindset was also recognized by the students themselves. One student said in an interview, “When answering questions now, we have to give reasons; we can't just give random answers.” This statement reflects the growth of cognitive awareness that every mathematical answer requires a strong argument. The teacher also added that students no longer focus solely on the final answer, but are beginning to get used to explaining the steps they used to arrive at their solution. In line with the results of the observation and interview, this is reinforced by documentation of students discussing with their group members to solve problems, as shown in Figure 2 below.

Figure 2. Group Discussion Activity in Completing Worksheets to Train Logical Reasoning skills

As visualized in Figure 2, the learning process entered the group investigation guidance stage, in which students were actively involved in intensive discussions to solve problems in the worksheets. Based on observations at this moment, strong collaborative dynamics were evident; students did not work individually but leaned toward the center of the table to examine the same problem. The discussion activity in Figure 2 is empirical evidence of critical thinking indicators, particularly the ability to provide logical reasoning. In this interaction, students exchange opinions to verify their answers. The students did not simply agree on the names of the shapes, but were observed arguing to explain why a shape was categorized as a square or a triangle by referring to the physical evidence (characteristics of the sides and angles) in front of them. This face-to-face interaction allows for scaffolding among peers, where students correct each other's understanding, making the problem-solving process more in-depth and accurate.

The third indicator is the ability to draw conclusions independently. In conventional learning processes, conclusions are usually dictated by the teacher. However, in this PBL model, students demonstrate independence in drawing conclusions after going through a process of investigation and discussion. Alignment with Piaget's Cognitive Development Theory is key to the success of this study. Given that students aged 7–11 are still in the concrete operational stage, the use of real objects such as classroom tiles or wall clocks proved crucial in helping them select relevant information (focus). This concrete foundation enabled students to process data to distinguish the properties of flat shapes with precision.

Discussion

Empirically, these findings reinforce Nisak's research, which found that a contextual approach to geometry material can significantly improve students' conceptual understanding (Nisak, 2023). However, this study provides a more in-depth emphasis than Mada's study. (Mada, Najoan., & Tarusu, 2024); If Mada focuses on high-level thinking outcomes, this study proves that the process of identifying problems in lower grades actually begins with students' ability to sort visual information in their surroundings. The evolution of reasoning skills in group discussions is the main highlight of this finding. There is a noticeable shift in communication patterns: students who initially only gave monosyllabic or brief responses gradually began to be able to explain causality—such as explaining the justification for why a shape is categorized as a rectangle based on the properties of its sides. This progressive phenomenon confirms an important principle: critical thinking competence at the elementary school level is not a talent that arises spontaneously, but rather a cognitive response that must be triggered by the relevance of the problems presented to the students' real world. This phenomenon can be explained through the perspective of Vygotsky's Social Constructivism, particularly the concept of the Zone of Proximal Development (ZPD). Through discussion, more capable students provide scaffolding to their peers, thereby triggering a more critical collective thinking process.

The success of students in constructing logical arguments during group discussions is in line with the findings of Sarwastuti and Purnomo, who specifically found that the application of PBL to geometry (circles) had a positive impact on students' mathematical critical thinking skills (Sarwastuti, & Purnomo, 2023). Unlike conventional learning, which often makes students passive, this study shows that integrating contextual problems can increase student engagement. This is in line with Desyandri's study, which highlights that the development of PBL modules integrated with the (multicultural) environmental context is highly valid and practical for use in elementary schools, and can facilitate students in constructing their own knowledge (Desyandri, Agustina, & Lusiana, 2024).

These findings are also consistent with recent research concluding that PBL facilitates collaboration skills that directly impact students' argumentation abilities. Unlike conventional learning, which tends to be one-way, dialogic interactions in PBL force students to verbalize their thoughts (Maryani, Riyadi, R., & Kurniawan, 2025; Wanelly & Fitria, 2019). In this context, this study successfully confirmed that Ennis' Reasoning indicator can be developed in III grade elementary school as long as students are given space to debate and correct each other in small groups.

At the final stage of learning, students demonstrate the ability to draw conclusions (inference) about the properties of flat shapes independently without being dictated to by the teacher. This indicates a shift in the role of students from passive recipients of knowledge to active constructors of knowledge. In accordance with the principles of constructivism, knowledge that is constructed by students themselves through a process of inquiry will remain in their long-term memory longer than knowledge that is memorized.

Conclusion

Based on the results of the analysis and discussion, it can be concluded that the implementation of the PBL model in flat shape material in grade III of SDN Cemengkalang has been carried out well through five syntactic stages that integrate contextual problems. The use of real objects in the school environment, such as wall clocks and tiles, has proven to be an effective cognitive bridge for students at the concrete operational stage to understand geometric concepts in depth. The final conclusion of this study confirms the effectiveness of PBL in strengthening students' mathematical critical thinking through three dimensions of achievement. Specifically, this strengthening was recorded in students' ability to sort essential data from contextual narratives (focus), a surge in the quality of logical arguments in discussion forums (reasoning), and students' independence in formulating and reflecting on conclusions related to geometric properties (inference). These findings confirm that critical thinking skills can be developed early on in lower grades if learning is facilitated with real-world problems and structured social interaction.

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