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The Effectıveness Of The Problem-Based Learnıng Model In Enhancıng Elementary Students' Learnıng Outcomes And Crıtıcal Thınkıng Skılls

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ABSTRACT
The low levels of critical thinking and academic achievement among elementary students highlight the need for student-centered instructional innovation. The Problem-Based Learning (PBL) model is considered a promising response because it emphasizes authentic problem solving and encourages analytical and collaborative thinking. This study analyzes the effectiveness of PBL in improving elementary students' learning outcomes and critical thinking skills. A quantitative approach was employed using a quasi-experimental posttest-only control group design. The participants were 55 fifth-grade students at SDN Tambaksawah: 30 in the experimental class taught with PBL and 25 in the control class taught with conventional methods. Data were analyzed using the Independent Samples t-Test at a 0.05 significance level. Results show a significant difference between groups, with Sig. (2-tailed) = 0.001 < 0.05. The experimental class achieved a mean score of 79.53, while the control class averaged 68.68; Cohen's d was 0.96 (large effect). These findings demonstrate that PBL effectively improves learning outcomes and critical thinking skills in elementary IPAS (Natural and Social Sciences) instruction.

Keywords: *Problem-Based Learning, learning outcomes, critical thinking, IPAS, elementary school*

ABSTRAK
Rendahnya kemampuan berpikir kritis dan hasil belajar siswa sekolah dasar menunjukkan perlunya inovasi pembelajaran yang berpusat pada siswa. Model Problem Based Learning (PBL) dipandang mampu menjawab tantangan tersebut karena menekankan pemecahan masalah autentik dan mendorong siswa untuk berpikir analitis serta kolaboratif. Penelitian ini bertujuan untuk menganalisis efektivitas penerapan PBL terhadap peningkatan hasil belajar dan keterampilan berpikir kritis siswa sekolah dasar. Metode penelitian menggunakan pendekatan kuantitatif dengan desain quasi experimental tipe posttest only control group design. Subjek penelitian adalah 55 siswa kelas V SDN Tambaksawah, terdiri atas 30 siswa kelas eksperimen yang menggunakan model PBL dan 25 siswa kelas kontrol dengan metode konvensional. Data dianalisis menggunakan uji Independent Samples t-Test dengan taraf signifikansi 0,05. Hasil penelitian menunjukkan perbedaan signifikan antara kedua kelompok dengan nilai Sig. (2-tailed) = 0,001 < 0,05. Nilai rata-rata hasil belajar kelas eksperimen sebesar 79,53, sedangkan kelas kontrol 68,68, dengan Cohen's d sebesar 0,96 (efek besar). Temuan ini membuktikan bahwa penerapan PBL efektif dalam meningkatkan hasil belajar dan keterampilan berpikir kritis siswa sekolah dasar pada pembelajaran IPAS.

Kata Kunci: Problem Based Learning, hasil belajar, berpikir kritis, IPAS, sekolah dasar

INTRODUCTION

The quality of education in Indonesia continues to face challenges, particularly in developing critical thinking and achieving satisfactory learning outcomes at the elementary level (Yustitia & Kusmaharti, 2024). National Assessment reports (Kementerian Pendidikan, Kebudayaan, Riset, 2023) and PISA (OECD, 2023) indicate that many Indonesian students have yet to reach minimum competency standards in numeracy and science. This suggests that classroom learning has not fully supported the development of higher-order thinking skills demanded by 21st-century education.

In practice, elementary classrooms remain dominated by conventional methods such as lectures and one-way Q&A (Farhan et al., 2021; Izzah et al., 2023; Kusmaharti & Yustitia, 2020; Wardani & Yustitia, 2017; Yustitia et al., 2025; Yustitia & Dian Kusmaharti, 2022). Such models position students as passive recipients, leading learning to focus on rote memorization rather than conceptual understanding. Consequently, students are less trained to think critically, analyze problems, and connect knowledge to real-life contexts (Yustitia et al., 2025). This condition also affects motivation and learning outcomes, especially in IPAS (Natural and Social Sciences), which requires scientific and reflective thinking.

Ideally, IPAS instruction should nurture curiosity, logical reasoning, and awareness of the relationships between natural phenomena and social life. In reality, however, IPAS activities often emphasize theoretical mastery without offering first-hand experiences to observe, investigate, and solve problems. As a result, IPAS loses its contextual value and fails to build comprehensive scientific thinking.

To address these issues, instructional models are needed that actively engage students, promote problem-solving, and create meaningful learning experiences. PBL is one such model. Following Barrows and Tamblyn (Nursulistyo et al., 2021; Thompson, 2019; Wahyuningtyas et al., 2023; Yustitia & Kusmaharti, 2022), PBL places real-world problems at the starting point of learning, prompting students to integrate knowledge, develop critical thinking, and independently find solutions. Through PBL, students not only grasp concepts theoretically but also learn to apply them in everyday contexts.

PBL aligns with the principles of Indonesia's Merdeka Curriculum, which emphasizes student-centered learning and strengthening essential competencies through contextual experiences Darmayanti et al., 2022; Faizah et al., 2025; Utama et al., 2023). In PBL, students identify problems, propose hypotheses, seek information from various sources, conduct inquiry, and communicate their findings, activities that cultivate critical, collaborative, and reflective thinking central to 21st-century learning.

Prior studies show that PBL positively affects learning outcomes and critical thinking. Mawarsari & Wardani (2022) reported that students taught via PBL experienced significant improvements in conceptual understanding and higher-order thinking compared to those taught conventionally. Similar findings were reported by Farhan et al., (2021) and (Izzah et al., 2023), who observed significant gains in science and numeracy outcomes among elementary students.

In Indonesia's elementary context, PBL is particularly relevant given students' cognitive development at the concrete operational stage (Taifah, 2020), where children learn most effectively through direct experience, exploration, and authentic problem solving. PBL thus suits children's natural ways of constructing meaning.

SDN Tambaksawah, a primary school exploring innovative approaches, faces similar challenges: limited student engagement and little variety in teaching methods. This study measures the effectiveness of PBL in improving learning outcomes and developing critical thinking in fifth-grade IPAS classes. A quantitative analysis provides empirical evidence of PBL's potential as a strategic alternative for improving learning quality in elementary schools.

Accordingly, the study is expected to contribute to the practice of problem-based learning in elementary settings and serve as a reference for teachers and policymakers in designing innovative, contextual, and critical-thinking-oriented instruction.

METHODS

Type and Design

This study is quantitative research because the data collected consist of numerical scores from students' learning-outcomes tests and critical-thinking observations, which were then analyzed using inferential statistics to test the hypotheses. The purpose of the study was to examine the effect of the Problem-Based Learning (PBL) model on IPAS learning outcomes and critical-thinking skills of elementary school students.

The research employed a quasi-experimental design because the researcher did not fully randomize subjects, but still involved two groups with relatively equivalent characteristics. The specific form of the design was a posttest-only control group design, meaning that only a final test was administered without a pretest.

The design can be illustrated as follows:

Group	Treatment	Posttest
Experiment	X (PBL model)	O_2
Control	– (Conventional)	O_2

Where:

× : instruction using the PBL model

– : conventional instruction (lecture and question–answer)

O_2 : the same posttest was administered to both groups

With this design, differences in posttest scores between the experimental and control groups indicate the effect of PBL on the dependent variables.

Data and Data Sources

This study used quantitative data, including: 1) IPAS learning-outcomes data (Y_1): Data were obtained from posttest scores on a learning-outcomes test in multiple-choice format. The scores represent students' mastery of IPAS basic competencies; 2) Critical-thinking data (Y_2): Data were obtained from scores on a critical-thinking observation sheet during and/or after instruction. The scores reflect students' critical-thinking ability based on Ennis' indicators; and 3) Supporting data (if needed): Such as student lists, classroom conditions, instructional

schedules, and documentation of PBL and conventional learning activities to support interpretation of results.

The data sources consisted of: 1) Primary data sources: The main data were collected directly from 55 fifth-grade students at SDN Tambaksawah, Sidoarjo Regency, consisting of: a) 30 students in the experimental class and 2) 25 students in the control class. Primary data were gathered through the learning-outcomes posttest and the critical-thinking observation. Supporting data were obtained from school documents and teacher information, such as: 1) student enrollment and class distribution data; 2) the IPAS curriculum for the even semester of 2023/2024; 3) teachers' instructional plans and learning tools; 4) school notes related to instructional implementation.

Data Collection Technique

Data collection in this study was carried out using two main instruments: an IPAS learning-outcomes test and a critical-thinking observation sheet. The learning-outcomes test consisted of 20 multiple-choice items developed according to fifth-grade IPAS basic competency indicators. Before administration, the test underwent content validation through expert judgment by two elementary education experts and one experienced IPAS teacher to ensure alignment between indicators, content, and items. A try-out was conducted in an equivalent class, and reliability analysis using Cronbach's Alpha produced a coefficient of 0.86, indicating high reliability. Critical-thinking data were collected through an observation sheet adapted from Ennis (2011), covering problem identification, logical reasoning, evidence evaluation, and concluding, using a 4-point Likert scale (1–4) where higher scores reflect stronger critical-thinking skills. After the experimental class received instruction using the PBL model and the control class received conventional teaching, both groups were given the same posttest, while critical-thinking observations were conducted during and/or immediately after instruction to obtain students' critical-thinking scores.

RESULTS AND DISCUSSION

Implementing PBL significantly improved learning outcomes and critical thinking in elementary IPAS. Descriptive analysis (SPSS v27) showed that the experimental class averaged 79.53, while the control class averaged 68.68, a 10.85-point difference. This indicates that problem-based instruction more effectively enhances conceptual understanding and scientific thinking than traditional instruction. These results align with classroom-based evidence from Indonesian elementary schools, as reported in Hadiyanti (2021), where problem-based learning consistently led to higher science achievement and critical-thinking scores compared to conventional approaches.

Assumption checks showed data suitable for parametric analysis. Shapiro–Wilk normality tests yielded p-values > 0.05 for both groups (normal distribution). Levene's Test produced a significance value of 0.656 > 0.05, indicating homogeneous variances. Thus, an Independent Samples t-Test was appropriate.

The t-test revealed a significant difference between groups: Sig. (2-tailed) = 0.001 < 0.05, confirming that PBL significantly affected IPAS learning outcomes. Cohen's d was 0.96, a large effect, indicating not only statistical significance but also strong practical significance for students' academic achievement. This large effect size is comparable to gains found in other elementary mathematics studies that implemented PBL to strengthen problem-solving skills,

where post-intervention scores improved markedly across cycles of classroom action research (Ramadhani et al., 2024).

Observation results further showed marked gains in critical-thinking skills among the experimental group. Students taught with PBL were more active in identifying problems, expressing opinions, conducting inquiry, and drawing evidence-based conclusions. Their average critical-thinking scores were 15% higher than the control group. Students also demonstrated greater confidence in articulating arguments and collaborated effectively in problem-based tasks (Edianto et al., 2022). Similar patterns of increased participation and reasoning have been noted when elementary students engage with PBL-based mathematics tasks, which encourage them to explain solutions, justify strategies, and transfer knowledge to new problems (Ramadhani et al., 2024).

These findings suggest that PBL fosters student autonomy and engagement in higher-order thinking (Arif et al., 2020; Mawarsari & Wardani, 2022). The problem-solving process, analyzing information, proposing hypotheses, and formulating solutions, makes learning more meaningful and aligned with 21st-century competencies. Overall, PBL effectively enhances learning outcomes and develops critical-thinking skills in elementary IPAS (Camacho et al., 2018; Izzah et al., 2023), and can be recommended as an innovative strategy consistent with student-centered learning and the Merdeka Belajar ethos at the elementary level.

This study shows that PBL significantly affects elementary students' IPAS learning outcomes and critical thinking. Differences in mean scores between the experimental and control classes indicate higher academic achievement among students taught through PBL. This underscores that student-centered approaches create more meaningful learning experiences and strengthen conceptual understanding.

Theoretically, these results support constructivist views that knowledge is not transmitted directly from teacher to student but actively constructed through thinking, exploration, and reflection. In PBL, students do not merely receive information; they discover, hypothesize, analyze data, and draw conclusions from empirical evidence, processes that stimulate higher-order thinking (analysis, evaluation, creation). As noted by Adiwiguna et al., (2019), PBL deepens conceptual understanding because learning centers on real-world problem solving that demands active cognitive engagement.

The findings also align with Merdeka Belajar principles, emphasizing contextual, collaborative, student-centered learning. In PBL, students work in small groups to solve everyday problems, fostering social skills, communication, and collaboration crucial to 21st-century learning. Teachers act as facilitators, guiding discussions and inquiry, rather than as the sole source of knowledge, making learning more interactive and empowering.

Consistent results were reported by (Utama et al., 2023), who found significant improvements in learning outcomes and critical thinking under PBL. Their students showed better information analysis and inter-topic connections. Wardani & Fiorintina (2023) likewise found positive effects on motivation and learner autonomy, as students felt challenged by authentic, relevant problems, highlighting that success hinges not only on content but on strategies that facilitate learning.

Gains in critical thinking under PBL can also be explained by students' active roles in identifying and formulating problems (Sari et al., 2021). Conventional instruction often has

students receive concepts without deep processing. In contrast, PBL requires them to solve complex issues by gathering information, evaluating alternatives, and making data-based decisions, directly practicing critical thinking. As Dewantari et al., (2022) note, critical thinking includes giving logical reasons, judging evidence, and drawing rational conclusions.

Practically, PBL transforms classroom dynamics to be more active and reflective. Students learn not only from teachers but also from peers through group discussions and shared reflection, fostering responsibility for learning and encouraging active participation at every stage. Significant gains in learning outcomes indicate strengthened conceptual understanding, beyond memorization.

Effectiveness, however, depends on teacher readiness and learning environments. Teachers must embrace the facilitator role, managing discussions, guiding inquiry, and fostering open, respectful climates. Supportive environments and collaboration are crucial. PBL implementation, therefore, requires teacher training, learning resources, and sound time management to ensure effectiveness.

In sum, PBL not only significantly improves students' learning outcomes but also contributes to developing critical-thinking skills, a key 21st-century competency. By centering students and providing space for interaction, experimentation, and reflection, PBL offers a relevant, effective strategy to make elementary IPAS more contextual, meaningful, and empowering.

CONCLUSION

Based on the analysis and discussion, PBL has a significant effect on improving elementary students' learning outcomes and critical-thinking skills in IPAS. Students taught with PBL achieved higher outcomes than those taught conventionally. The Independent Samples t-Test yielded Sig. = 0.001 < 0.05 with Cohen's d = 0.96 (large effect), indicating a strong statistical and practical impact on academic achievement.

PBL also develops critical-thinking skills through authentic problem-solving processes. Students actively identify problems, seek information, analyze data, and draw evidence-based conclusions, strengthening logical, analytical, and reflective thinking central to 21st-century learning.

Pedagogically, PBL is an effective strategy to transform elementary IPAS into contextual, participatory, and student-centered learning. Its implementation aligns with Merdeka Belajar, nurturing learners who are independent, critical, and adaptive. Teachers are encouraged to integrate PBL sustainably to build students' academic competencies and critical thinking from the earliest grades.

RECOMMENDATİONS

Elementary teachers are encouraged to implement PBL consistently, as it effectively improves learning outcomes and critical-thinking skills. Schools should support this through teacher training and the provision of resources that enable contextual and collaborative PBL. Future research could broaden the scope by examining PBL's effects on motivation, science literacy, or complex problem-solving and by integrating digital technologies to make learning more engaging and relevant to 21st-century needs.

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