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The Influence of Problem-Based Learning (PBL) and Self-Efficacy on Critical Thinking Skills of Elementary School Level

Muhammad Choerul Umam[1]✉, Anton Subarno[2] Patni Ninghardjanti[3] & Ahmad Ziddan Wildan Al-Islami[4]

[1]✉Universitas Sebelas Maret, mc_umam07@staff.uns.ac.id, Orcid ID: 0000-0003-0874-7646
[2] Universitas Sebelas Maret, pakanton@staff.uns.ac.id, Orcid ID: 0000-0003-1447-7603
[3] Universitas Sebelas Maret, ning@staff.uns.ac.id, Orcid ID: 0000-0002-4463-6620
[4] Istanbul University, Türkiye, a.islami.20@ogr.iu.edu.tr, Orcid ID: 0009-0006-1757-9276

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Abstract

This study aims to determine the effect of Problem-Based Learning (PBL) and self-efficacy on students' critical thinking, and the effect of PBL on critical thinking skills with self-efficacy as a mediating variable. Unlike prior PLS-SEM research that largely targets higher-education contexts, this study extends the structural model to the elementary level. A quantitative explanatory design was used with a purposive sample of 138 sixth-grade students at SD International Al Abidin Surakarta. Data were collected using a validated academic self-efficacy questionnaire and a higher-order thinking skills (HOTS)-based critical thinking test after PBL implementation. Data were analyzed using PLS-SEM through measurement and structural model evaluation and bootstrapping for hypothesis testing. Results show that the measurement model met convergent and discriminant validity and reliability criteria. In the structural model, PBL and academic self-efficacy jointly explained a substantial portion of variance in critical thinking (R^2 = 0.618); effect-size estimates indicated moderate contributions for PBL (f^2 = 0.294) and self-efficacy (f^2 = 0.335), and predictive relevance was acceptable (Q^2 = 0.358). Hypothesis tests indicate significant direct effects of PBL on critical thinking ($t = 7.145$, $p < 0.001$) and of academic self-efficacy on critical thinking ($t = 7.097$, $p < 0.001$). PBL strongly affected academic self-efficacy ($t = 15.066$, $p < 0.001$), and the mediating pathway through self-efficacy was significant ($t = 19.253$, $p < 0.001$). The findings suggest that implementing PBL while supporting students' academic self-efficacy can effectively enhance critical thinking in elementary education.

Keywords: Critical Thinking, Problem-Based Learning, Self-Efficacy

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Abstrak

Penelitian ini bertujuan untuk mengetahui pengaruh Pembelajaran Berbasis Masalah (PBL) dan efikasi diri terhadap kemampuan berpikir kritis siswa, serta pengaruh PBL terhadap kemampuan berpikir kritis dengan efikasi diri sebagai variabel mediasi. Berbeda dengan penelitian PLS-SEM sebelumnya yang sebagian besar berfokus pada konteks pendidikan tinggi, penelitian ini memperluas model struktural tersebut ke tingkat sekolah dasar. Desain eksplanatori kuantitatif digunakan dengan sampel purposif sebanyak 138 siswa kelas enam di SD International Al Abidin Surakarta. Data dikumpulkan menggunakan kuesioner efikasi diri akademik yang telah divalidasi dan tes berpikir kritis berbasis keterampilan berpikir tingkat tinggi (HOTS) setelah implementasi PBL. Data dianalisis menggunakan PLS-SEM melalui evaluasi model pengukuran dan struktural serta bootstrapping untuk pengujian hipotesis. Hasil menunjukkan bahwa model pengukuran memenuhi kriteria validitas konvergen dan diskriminan serta reliabilitas. Dalam model struktural, PBL dan efikasi diri akademik secara bersama-sama menjelaskan sebagian besar varians dalam berpikir kritis ($R^2 = 0{,}618$); estimasi ukuran efek menunjukkan kontribusi sedang untuk PBL ($f^2 = 0{,}294$) dan efikasi diri ($f^2 = 0{,}335$), serta relevansi prediktifnya dapat diterima ($Q^2 = 0{,}358$). Uji hipotesis menunjukkan adanya pengaruh langsung yang signifikan dari PBL terhadap pemikiran kritis ($t = 7{,}145$, $p < 0{,}001$) dan dari efikasi diri akademik terhadap pemikiran kritis ($t = 7{,}097$, $p < 0{,}001$). PBL sangat memengaruhi efikasi diri akademik ($t = 15{,}066$, $p < 0{,}001$), dan jalur mediasi melalui efikasi diri signifikan ($t = 19{,}253$, $p < 0{,}001$). Temuan ini menunjukkan bahwa penerapan PBL sambil mendukung efikasi diri akademik siswa dapat secara efektif meningkatkan pemikiran kritis dalam pendidikan dasar.

Kata Kunci: Berpikir Kritis, Pembelajaran Berbasis Masalah, Efikasi Diri

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INTRODUCTION

Critical thinking is one of the essential 21st-century skills that should be fostered from the elementary education level (Chalkiadaki, 2018; Sarwanto et al., 2021). For young learners, critical thinking refers to the ability to make reasoned judgments about what to believe or what actions to take through an active, careful, and reflective thinking process. This skill is reflected in children's curiosity, their ability to ask meaningful questions, and their capacity to explain the reasoning behind their ideas (Ennis, 2018). Through critical thinking, students learn to analyze information, evaluate sources, and consider evidence before drawing conclusions, which are fundamental abilities for problem-solving in both academic and everyday contexts (Dwyer et al., 2014; Halpern & Dunn, 2021).

The development of critical thinking enables students to understand information more deeply and to make decisions based on logical and objective considerations (Baki, 2025; Sarwanto et al., 2021). Students with well-developed critical thinking skills are more capable of distinguishing valid information from biased or unsupported claims, communicating their ideas clearly, and adapting to new and complex situations (Redaelli et al., 2025; Thornhill-Miller et al., 2023). Moreover, learning environments that emphasize critical thinking encourage collaboration and respectful communication, as students learn to listen to diverse perspectives and justify their opinions with sound arguments (Akpur, 2020; Bezanilla et al., 2019; Cáceres et al., 2020).

Despite its importance, critical thinking skills among elementary school students are still relatively underdeveloped. Although international assessments such as PISA (OECD, 2019) primarily evaluate older students, consistently low national performance indicates that the foundations of critical thinking may not be sufficiently established at earlier educational stages. Elementary students often experience difficulties when asked to analyze information deeply, identify patterns, or question the validity of given facts. These challenges are frequently associated with learning practices that do not optimally stimulate students' curiosity, reasoning processes, and investigative skills (Sarwanto et al., 2021).

In the context of this study, similar conditions were identified among sixth-grade students at SD International Al Abidin Surakarta based on preliminary observations conducted systematically through classroom observations using a structured observation checklist that assessed student engagement in analytical tasks, frequency of higher-order questioning, and evidence of reflective reasoning during lessons. The observation was conducted over two weeks across seven learning groups, with each session lasting approximately 40 minutes. Additionally, informal semi-structured discussions with five classroom teachers were carried out to triangulate the observational findings, which collectively served as an initial needs analysis prior to the main study. These preliminary findings indicated that many students tended to rely on memorization rather than analytical reasoning. This was particularly evident when students encountered questions requiring Higher Order Thinking Skills (HOTS), which are an integral component of the Cambridge curriculum implemented at the school. Students were often hesitant to ask probing questions, provide reasoned opinions, or thoroughly analyze newly introduced material, indicating that their critical thinking skills had not yet developed optimally.

Instructional strategies play a crucial role in shaping students' critical thinking abilities. Not all learning models are equally effective in facilitating critical thinking skills. Learning approaches that emphasize teacher-centered instruction and procedural knowledge tend to limit students' opportunities to analyze problems, evaluate evidence, and construct arguments independently. In contrast, learning models grounded in constructivist principles actively engage students in higher-order cognitive processes. One instructional approach that has been widely recognized for its potential to promote critical thinking is Problem-Based Learning (PBL). PBL emphasizes student-centered learning through engagement with authentic problems, encouraging learners to analyze situations, propose solutions, collaborate with peers, and reflect on their reasoning processes. These characteristics make PBL particularly

appropriate for facilitating students' critical thinking development, as students are required to actively construct knowledge rather than passively receive information (Almulla, 2020; Loyens et al., 2015; Merritt et al., 2017). A recent literature review by Susilawati and Supriyatno (2023) further confirms that PBL effectively enhances critical thinking among elementary school students by encouraging active problem-solving and collaborative inquiry.

In addition to instructional approaches, students' psychological factors also contribute significantly to the development of critical thinking skills. Not all psychological variables exert the same influence on higher-order thinking. This study focuses specifically on academic self-efficacy, defined as students' beliefs in their ability to successfully perform academic tasks (Akhmedjanova, 2024; Greco et al., 2022; Honicke & Broadbent, 2016; Schunk & DiBenedetto, 2020). Academic self-efficacy is theoretically linked to critical thinking because students who believe in their cognitive capabilities are more willing to engage in complex reasoning, persist in solving challenging problems, and apply higher-order thinking strategies during learning activities. Students with higher self-efficacy tend to demonstrate greater motivation, resilience, and cognitive engagement, which are essential for effective critical thinking.

Although previous studies have examined the relationship between learning models and critical thinking skills, most focus on direct effects and are conducted at the secondary or higher education levels. Limited research has explored how self-efficacy functions as a mediating mechanism through which instructional models influence students' critical thinking skills, particularly in elementary education contexts. Therefore, this study aims to examine the influence of Problem-Based Learning and academic self-efficacy on elementary school students' critical thinking skills, with self-efficacy positioned as a mediating variable. The findings of this study are expected to provide empirical insights for designing instructional strategies that not only enhance students' critical thinking abilities but also strengthen their academic confidence from an early age.

METHODS

This study employed a quantitative explanatory research design aimed at examining the structural relationships among variables. The research was conducted at SD International Al Abidin Surakarta, which is located at Jl. Adi Sumarmo, Banyuanyar, Banjarsari District, Surakarta City, Central Java, Indonesia. The study was carried out from September 2024 to February 2025.

The population of this study comprised all sixth-grade students at SD International Al Abidin Surakarta, who were organized into seven learning groups during the 2024/2025 academic year. A purposive sampling technique was applied to select participants based on specific criteria, namely that students were officially enrolled as sixth-grade students during the research period, participated in learning activities using the Problem-Based Learning (PBL) approach, and completed all learning sessions and research instruments required in the study. Based on these criteria, the final sample consisted of 138 students, representing the entire accessible population that met the inclusion requirements.

This study involved two exogenous variables and one endogenous variable. The exogenous variables were Problem-Based Learning (PBL) (X_1) and academic self-efficacy (X_2), while critical thinking skills (Y) served as the endogenous variable.

The learning model implemented in this study was Problem-Based Learning (PBL), which was conducted following its core instructional stages. These stages included problem orientation, problem definition and understanding, information gathering and investigation, development and presentation of solutions, as well as reflection and evaluation. These stages were designed to actively engage students in analyzing problems, proposing solutions, and reflecting on their reasoning processes, thereby supporting the development of critical thinking skills.

Data were collected using two main instruments, namely a self-efficacy questionnaire and a critical thinking skills test. The self-efficacy questionnaire was developed to measure students' academic self-efficacy using a Likert-scale format, while the critical thinking skills test was constructed based on

indicators of higher-order thinking skills (HOTS). Both instruments were administered after the implementation of the PBL learning activities.

Instrument validation was conducted using the measurement model (outer model) approach in SmartPLS 4. Convergent validity was assessed through factor loadings and Average Variance Extracted (AVE), while discriminant validity was evaluated using the Fornell–Larcker criterion and cross-loadings. Instrument reliability was examined using Cronbach's alpha and composite reliability values.

Data analysis was performed using SmartPLS 4 software. The analysis involved two main stages, namely evaluation of the measurement model (outer model) and evaluation of the structural model (inner model), which included determination coefficients (R^2), path coefficients, effect size (f^2), and predictive relevance (Q^2). Hypothesis testing was conducted using the bootstrapping method to determine t-statistics and p-values for assessing the significance of direct and indirect effects among variables.

This study adhered to ethical principles in educational research involving children. Prior to data collection, permission was obtained from the school authorities, and written informed consent was secured from parents or legal guardians of all participating students. Students' participation was voluntary, and they were informed that they could withdraw from the study at any time without any academic consequences. To ensure confidentiality, participants' identities were anonymized, and all collected data were used solely for research purposes. The study did not involve any procedures that posed physical or psychological risks to the participants, and all learning activities were conducted as part of regular classroom instruction.

RESULTS AND DISCUSSION

A pilot test of the research instrument was conducted. Data analysis through PLS-SEM is carried out in three stages, namely the measurement model (outer model), structural model (inner model), and hypothesis testing.

Table 1. Measurement Model

Variables/ Constructs	Loading Factor	Composite Reliability	Cronbach's alpha	AVE
Critical Thinking		0.844	0.839	0.609
BK.1	0.792			
BK.2	0.819			
BK.3	0.811			
BK.4	0.764			
BK.5	0.712			
Problem-Based Learning (PBL)		0.873	0.841	0.612
MP.1	0.835			
MP.2	0.703			
MP.3	0.870			
MP.4	0.720			
MP.5	0.768			
Self-efficacy		0.889	0.869	0.660
SE.1	0.840			
SE.2	0.857			
SE.3	0.874			
SE.4	0.806			
SE.5	0.666			

The measurement model evaluation was performed to assess convergent validity, reliability, and internal consistency. As shown in Table 1, all indicator loadings exceeded the recommended threshold of 0.70, indicating strong relationships between the indicators and their respective constructs. The Composite Reliability and Cronbach's alpha values for all constructs were above 0.70, confirming satisfactory internal consistency. In addition, the Average Variance Extracted (AVE) values for all constructs exceeded the minimum criterion of 0.50, demonstrating adequate convergent validity. These results indicate that all measurement items were reliable and valid for further analysis.

Table 2. Structural Model

Variables & constructs H1 and H2	R^2	F^2	Q^2
Problem-Based Learning (PBL)		0.294	
Self-efficacy		0.335	
Critical thinking	0.618		0.358

The structural model evaluation was conducted to examine the explanatory power and predictive relevance of the proposed model. As presented in Table 2, the R-square (R^2) value for critical thinking was 0.618, indicating that 61.8% of the variance in students' critical thinking skills was explained jointly by Problem-Based Learning (PBL) and self-efficacy. The effect size analysis showed that PBL ($f^2 = 0.294$) and self-efficacy ($f^2 = 0.335$) had moderate effects on critical thinking. Furthermore, the predictive relevance value ($Q^2 = 0.358$) was greater than zero, confirming that the model had good predictive capability. According to Hair et al. (2019), the predictive relevance (Q^2) values can be categorized as small (0.02), medium (0.15), and large (0.35). The Q^2 value for critical thinking in this study was 0.358, which exceeds the threshold for large predictive relevance, indicating that the model demonstrates strong predictive capability in explaining the variance of students' critical thinking skills.

Table 3. Structural Model Results for the Mediating Effect of Self-Efficacy

Variables and constructs H3	**R^2**	**F^2**	**Q^2**
Problem-Based Learning (PBL)		0.596	
Self-Efficacy (*Mediation)*	0.374	0.995	0.241
Critical thinking	0.499		0.287

Table 3 presents the R-square value on endogenous variables, where self-efficacy as mediation has a value of 0.374 or 37.4%, and critical thinking has a value of 0.499 or 49.9%. This shows that self-efficacy can explain the causal relationship with the Problem-Based Learning (PBL) strongly, and the Problem-Based Learning (PBL) can also explain the causal relationship with self-efficacy strongly. Furthermore, based on the effect size value, the effect of the Problem-Based Learning (PBL) on Self-Efficacy has a value of 0.596 or 59.6%, which is included in the large influence category. Meanwhile, the effect of Self-Efficacy on Critical Thinking has a value of 0.995 or 99.5%, which is also classified as a large effect. Based on the analysis results, the Predictive Relevance (Q^2) value for the endogenous variable Self-Efficacy (SE) is 0.241, and for Critical Thinking (BK) is 0.287. Both of these values are greater than zero, indicating that the model has a good predictive ability of the two variables. Specifically, the model can explain 24.1% of the variability in Self-Efficacy (SE) and 28.7% of the variability in Critical Thinking (BK). This result indicates that the model is quite effective in predicting both variables.

Table 4. Hypothesis Test

Path	**t-statistic**	***p-value***
Problem-Based Learning (PBL) => Critical thinking	7.145	0.000
Self-efficacy => Critical thinking	7.097	0.000
Self-efficacy (mediation) => Critical thinking	19.253	0.000
Problem-Based Learning (PBL) => Self-efficacy (mediation)	15.066	0.000

In Table 4, based on the results of hypothesis testing, the T-statistic value for the relationship between Problem-Based Learning (PBL) variables and critical thinking is 7.145, while the T-Statistic value for the relationship between self-efficacy and critical thinking is 7.097 which is greater than the threshold value of 1.96. In addition, the second p-value of 0.000 is also much smaller than 0.05. Thus, the test results indicate statistical significance. That is, there is a positive and significant influence between Problem-Based Learning (PBL) and critical thinking, and there is a positive and significant influence between self-efficacy and critical thinking. These results support the theory or concept that states that Problem-Based Learning (PBL) and self-efficacy have an important role in critical thinking. Based on the test results on the mediation variable, it shows that the Problem-Based Learning (PBL) has a significant effect on self-efficacy as mediation, with a T-statistic value of 15.066, which exceeds the threshold of 1.96, and a p-value of 0.000, which is smaller than 0.050. In addition, self-efficacy is also proven to have a significant effect on critical thinking skills with a T-statistic value of 19.253, which is far above 1.96, and a p-value of 0.000.

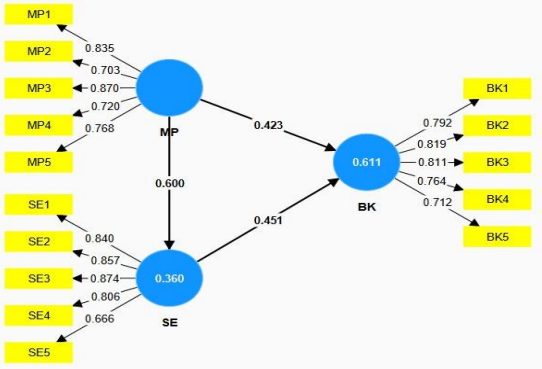

Figure 1. Research Path Model

Discussion

Critical thinking is one of the most important skills elementary students need to develop to face challenges in their learning. These skills include the ability to analyze information, evaluate ideas, and find solutions based on a deep understanding of a problem. In the classroom, critical thinking is a key sign of educational success because it helps children understand concepts deeply and apply them to real situations. However, challenges in developing these skills are common. National assessments of older students have highlighted that analytical abilities are often an area for improvement, suggesting that the foundations for critical thinking must be built early. The ability to think critically provides a clear direction for learning and helps children accurately connect ideas, making it essential for problem-solving in their schoolwork (Fabio et al., 2023; Halpern & Dunn, 2021).

Based on the research, the Problem-Based Learning (PBL) a teacher uses has a significant influence on an elementary student's critical thinking skills because the right methods encourage deeper thinking. Activities like group discussions, hands-on science experiments, and collaborative projects help children develop these skills. The research also shows that applying the right Problem-Based Learning (PBL) can increase a student's confidence and motivation to think analytically. Thus, Problem-Based Learning (PBL) is not just a way to share information, but a powerful means to shape a child's critical thinking patterns.

The results showed that the MP3 statement item, namely "I always feel encouraged to actively participate in the learning process," had the highest score (0.873). This finding aligns with research by Mazna et al. (2024), which shows that interactive learning involving active students is a very effective way to develop critical thinking. Through methods like problem-based learning, role-playing a historical event, or inquiry-based science experiments, students don't just receive knowledge. Instead, they are invited to think critically, evaluate information, and make decisions based on what they learn.

As shown in Table 1, the results indicated that the SE3 indicator item, namely 'I always see the positive side of the challenges I face,' obtained the highest loading factor value (0.874) among all self-efficacy indicators. This aligns with research by Melyana & Pujiastuti (2020), which shows that students with high optimism or self-confidence have stronger critical thinking skills. Elementary students with this positive outlook are often not afraid to take risks in their learning, like trying a difficult math problem or sharing a creative idea for a project. This finding is further supported by research from Akhmedjanova (2024) and Yan et al. (2022), which states that when a student's self-efficacy is strong, it has a direct positive impact on their ability to think critically.

The new finding of this research is that self-efficacy acts as a bridge, strengthening the connection between Problem-Based Learning (PBL) and critical thinking skills. Elementary school students with high self-efficacy are more confident when facing challenges in their learning. For example, during a problem-based learning activity, these students are more likely to believe they can complete their tasks successfully. With strong self-efficacy, students don't just understand the material; they are also able to evaluate ideas and apply what they've learned to solve new problems.

Research by Saepuloh (2021) confirms the link between Problem-Based Learning (PBL), self-efficacy, and a student's critical thinking skills. Applying the right Problem-Based Learning (PBL) helps children become more engaged and active participants in their own learning, while self-efficacy works to build their confidence and motivation to tackle difficult schoolwork. This combination leads

to improved critical thinking. The study shows that children who believe in themselves are better able to analyze information, evaluate different ideas, and solve problems thoughtfully. Thus, combining a supportive Problem-Based Learning (PBL) with a focus on building self-efficacy can lead to better overall learning outcomes. Therefore, helping students build self-confidence is a crucial part of any educational effort to improve their critical thinking skills.

CONCLUSION

Based on the study's results, it can be concluded that for elementary school students, there is a significant effect of the Problem-Based Learning (PBL) on critical thinking (t-statistic = 7.145, p-value = 0.000) and a significant effect of self-efficacy on critical thinking (t-statistic = 7.097, p-value = 0.000). Most importantly, the research confirms a significant pathway where the Problem-Based Learning (PBL) boosts self-efficacy, which in turn enhances critical thinking skills (t-statistic = 19.253, p-value = 0.000). Based on these findings, students are encouraged to actively participate in class by discussing, asking questions, and completing tasks, while also building confidence by not being afraid to make mistakes. Teachers are advised to use creative and interactive learning materials, such as videos or educational games, to motivate students. This study has several limitations. First, the research was only conducted at SD International Al Abidin Surakarta, so the results may not apply to other schools with different conditions. Second, the study used only quantitative analysis and did not explore in-depth other factors that might affect a student's critical thinking. Finally, the effectiveness of Problem-Based Learning (PBL) can vary depending on a child's individual learning style, which was not fully analyzed in this study.

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