



Students' Critical Thinking Abilities Assessed From the Implementation of the Problem-Based Learning Model: Systematic Literature Review

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Article Info

Article history:

Received November 30, 2025

Approved February 15, 2026

Keywords:

Problem-Based Learning, critical thinking, systematic literature review, PBL, education

ABSTRACT

In the 21st century, critical thinking is a crucial skill that must be developed through effective learning practices. Because it requires students to analyze, formulate, and solve contextual problems, the problem-based learning (PBL) model is considered to enhance their critical thinking skills. The effect of PBL implementation on students' critical thinking skills was examined in the study discussed in this article. Related keywords were used to conduct a search of indexed journal databases (SINTA 2 and Scopus) for the period from 2018 to 2025. A total of eight relevant primary articles were found and evaluated. The results indicate that the majority of studies indicate that PBL implementation improves critical thinking skills. The quality of the problems, the teacher's role as a facilitator, and the use of authentic assessments are key factors contributing to the success. Recommendations for practice and further research are provided.

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How to cite: Adi, N. N. S., Lasmawan, I. W., & Parmiti, D. P. (2026). Students' Critical Thinking Abilities Assessed From the Implementation of the Problem-Based Learning Model: Systematic Literature Review. *Jurnal Ilmiah Global Education*, 7(1), 702–713. <https://doi.org/10.55681/jige.v7i1.5068>

INTRODUCTION

Intelligent, creative, and adaptive human resources, who face the challenges of global life, are developed through education. Due to advances in science, technology, and digitalization during the 21st century, the world of education is undergoing rapid transformation. In this situation, the education system must enhance higher-order thinking skills, also known as higher-order thinking skills (HOTS). HOTS encompasses the ability to analyze, evaluate, and create (analyze, evaluate, and create), as well as critical thinking skills (Anderson & Krathwohl, 2010). Critical thinking skills, also known as critical reasoning skills, are defined as the critical and logical thought processes used to make choices about what to believe or do (Ennis, 2018).

Identifying problems, collecting and evaluating data, drawing sound conclusions, and making decisions based on sound reasoning and evidence are all skills of critical thinkers. Critical thinking in education is not just an academic skill; it is a life skill essential for navigating current

and future social, economic, and technological challenges (Facione, 2015). As demonstrated by various international evaluation results, the critical thinking skills of Indonesian students still require improvement.

The 2018 Program for International Assessment (PISA) results showed that Indonesia ranked 72nd out of 78 participating countries in science and mathematics literacy; this score is far below the OECD average (Ministry of Education and Culture, 2020). This indicates that Indonesian students still lack critical thinking, analysis, and problem-solving skills. The teacher-centered learning paradigm remains dominant, a major contributing factor to low critical thinking skills. Teachers primarily act as sources of information, while students passively receive information. Students are limited in opportunities to reason, analyze, and evaluate information because practice problems and rote lecture methods are still widely used (Nuryanti, Zubaidah, & Diantoro, 2018). This type of learning contradicts the educational concept of involving students as active participants in the learning process. Furthermore, educational evaluations in Indonesia often focus on critical and creative thinking processes rather than lower cognitive aspects such as concept mastery or memorization.

However, the currently used Independent Curriculum emphasizes the importance of competency-based learning and the development of Pancasila student profiles that focus on critical thinking and scientific reasoning. Therefore, a new learning model is needed that is challenging, active, and encourages students to think critically. Problem-Based Learning (PBL) is a learning model that has been proven effective in improving critical thinking skills. PBL begins learning with contextual problems. This model was first developed by Howard Barrows and Tamblyn at the Faculty of Medicine at McMaster University in Canada (1980). It was then adapted to various disciplines and educational levels. With the PBL model, students are faced with real problems that they must solve independently.

According to Hmelo-Silver (2019), the learning process consists of five steps: (1) problem orientation; (2) organizing learning activities; (3) independent inquiry; (4) developing and presenting work results; and (5) analyzing and reflecting on the problem-solving process. Students actively participate in each step: asking questions, seeking information, discussing ideas, and evaluating their own thinking. Therefore, PBL not only improves cognitive abilities but also teaches people to be responsible, collaborate, and reflect on themselves. PBL improves critical thinking skills, according to research. As shown by Ahmadita, Mubarok, and Prahani (2021), the critical thinking skills of high school students in dynamic electricity were improved by using the PBL model, aided by PhET simulations. Compared to students taught with conventional methods, students who learned with PBL showed better abilities in analyzing and evaluating mathematical arguments, according to another study conducted by Harianja, Tampubolon, and Manalu (2023).

Furthermore, research conducted by Putranta and Kuswanto (2018) found that problem-based learning with interactive media can enhance students' critical thinking skills and foster their scientific curiosity. In addition to enabling cognitive development, PBL aligns with the theory of constructivist learning. This theory emphasizes that students actively construct knowledge through their learning experiences (Piaget, 1972; Vygotsky, 1978). Students not only acquire knowledge from teachers but also from the teacher's experience.

METHODS

To ensure a systematic and transparent research process, this study followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The 312 articles retrieved were published between 2018 and 2025. Literature data from various relevant scientific journals were collected using the PICO approach. This study analyzed articles examining critical thinking skills using a problem-based learning model. This method enables the screening of articles that meet the specified criteria. In this study, the PICO criteria used are as follows:

Table 1. PICO Criteria

PICO Criteria	Description
Population	Articles discussing students from various educational levels (elementary, middle, and high school) who implemented the problem-based learning model to measure critical thinking skills.
Intervention	studies implementing the PBL model as the primary model to measure improvements in students' critical thinking skills.
Comparison	Studies comparing improvements in students' critical thinking skills using the PBL learning model and conventional/lecture learning methods.
Outcome	The results measured in the articles include improvements in students' critical thinking skills.

Search Strategy and Study Selection

Electronic databases were used to search for articles relevant to this research topic. The database used was Google Scholar. Using Zotero reference management software, article records and metadata were compiled, titles and abstracts were screened, and each full-text article was then reviewed to ensure compliance with the established inclusion criteria (Zaharah et al., 2020). The search strategy in Google Scholar and other databases was conducted using keywords relevant to the research theme. The following search strategy was applied: 'Problem-Based Learning', 'critical thinking', 'critical thinking skills', 'students', 'systematic review'. This search strategy combined several primary keywords to identify articles relevant to the topic of Improving Students' Critical Thinking Skills, as reviewed through the Application of the Problem-Based Learning Model. Publication year restrictions were used to ensure that the selected articles were published within the relevant timeframe, namely 2018-2025.

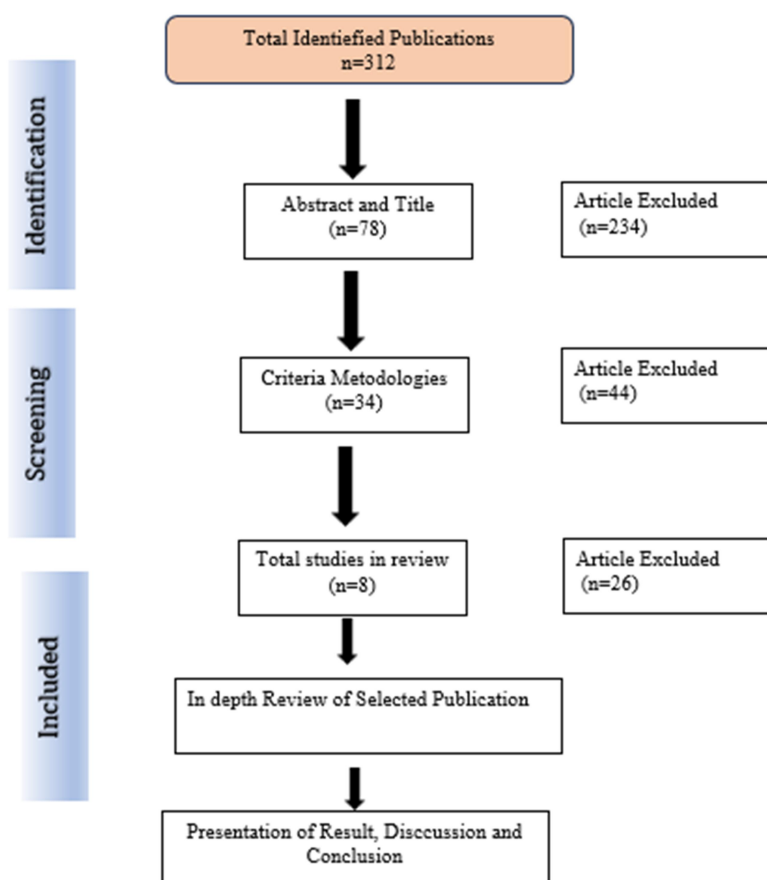


Figure 1. Article Search PRISMA Chart

Inclusion and Exclusion Criteria

This study focused on providing high-quality papers, adhering to strict inclusion and exclusion criteria. The inclusion criteria for this literature review were: (1) empirical articles or reviews focusing on the influence of PBL on critical thinking; (2) published between 2018 and 2025; (3) educational levels for elementary, middle, and high school; (4) articles in Indonesian or English; and (5) published in SINTA 2 journals or Scopus-indexed journals. Exclusion criteria included duplicates, articles without clear methods, and articles published outside the specified year range.

The article screening process began by identifying a total of 312 articles based on the established inclusion criteria. After screening based on title and abstract, 78 articles were obtained. Of these 78 articles, an assessment was conducted for methodological criteria, with 34 articles meeting the inclusion criteria. A final analysis was then conducted with complete questionnaires, resulting in eight primary articles selected according to the inclusion criteria and included in the mathematical review. The selected articles were published between 2018 and 2025 (Adedoyin & Soykan, 2020). To compile the metadata for the selected articles, the authors used the Zotero application, which facilitates checking the completeness of each article's metadata. Several articles with incomplete metadata had to be corrected by the researchers to ensure more accurate data for this study (Gil-Arias et al., 2021).

RESULTS AND DISCUSSION

Result

This study reviewed relevant articles on critical thinking skills from the perspective of implementing the problem-based learning model. The following is a summary of the article review results based on the characteristics of the title, research focus, main findings, author, and year of publication.

TITLE	RESEARCH FOCUS	KEY FINDINGS	AUTHOR & YEAR
Implementasi Pendekatan STEM dalam Meningkatkan Kemampuan Berpikir Kreatif dan Kemampuan Berpikir Kritis Matematik	The Effect of STEM Integration (with PBL) on Mathematical Critical Thinking.	Significant Improvement in Critical Thinking Skills in Mathematics Students; Greater Effectiveness When Combined with Reflection and Authentic Assessment.	Rahmawati, L., dkk. (2023)
Analysis of Student's Critical Thinking in Chemistry Learning: Systematic Literature Review.	Critical Thinking Skills in Chemistry Learning Through Various Models, Including PBL.	PBL Shows Positive Results, Especially in Analyzing and Synthesizing Chemical Concepts.	Putri, S. E. (2023).
Students' Critical Thinking Skills in Solving Mathematical Problems: A Systematic Literature Review	Critical Thinking in Mathematical Problem Solving with PBL Interventions	PBL Effectively Improves Problem-Solving and Critical Thinking Skills; Variation in Results Related to Teacher Instruction.	Suryawan, I. P. P. (2023).
Optimalisasi Kemampuan Berpikir Kritis melalui Metode Flipped Classroom: Systematic Literature Review	The Relationship Between Flipped Classroom and PBL on Critical Thinking Development.	The Combination of the Flipped Classroom with PBL Increases Student Engagement and Critical Thinking.	Latifah, N. (2024).

Pengaruh Problem Based Learning pada Pembelajaran Matematika terhadap Kemampuan Berpikir Kritis: Systematic Review	The Effectiveness of PBL in Mathematics Subjects	PBL is effective, but its effectiveness is influenced by the quality of the problems and the duration of implementation	Lestari, C. A., dkk. (2024).
Enhancing Students' Critical Thinking in Mathematics: A Systematic Literature Review.	Mathematics Teaching Strategies Support Critical Thinking	Collaborative strategies and process assessments help improve critical thinking	Nafiah, S. (2024)
Efektivitas Media Pembelajaran Berbasis Android pada Pengembangan Berpikir Kritis Siswa SD: Systematic Literature Review	The Role of Digital Media in PBL for Elementary Schools	Mobile media supports investigative and reflective activities, accelerating the development of critical thinking.	Sarida N. A. (2023).
Tinjauan Pustaka Sistematis: Kemampuan Berpikir Kritis Siswa Ditinjau dari Motivasi Belajar	The Relationship Between Learning Motivation and Critical Thinking in the Context of PBL	Intrinsic motivation strengthens PBL outcomes in improving critical thinking	Antara, I. D. G. J., dkk. (2023)

Discussion

According to the assessment of eight articles indexed by SINTA 2 and related to students' critical thinking skills in the implementation of problem-based learning (PBL), most of the research was conducted in elementary and secondary schools, particularly in mathematics and science subjects. The research methods used were predominantly systematic literature reviews (SLR) and quantitative experimental studies, with a primary focus on critical thinking skills and the PBL model. Of the eight articles analyzed, six explicitly stated that PBL was the primary model used, while the other two linked it to other innovative models, such as the folded classroom and the STEM approach. This suggests that current research trends may be shifting toward the development of hybrid models, which combine PBL with other learning strategies to enhance learning outcomes, particularly critical thinking skills.

Furthermore, each article reviewed demonstrated that problem-based learning has a significant positive effect on students' critical thinking skills. For example, research by Rahmawati et al. (2023) and Lestari et al. (2024) demonstrated that PBL can enhance students' critical thinking skills by encouraging them to actively analyze problems, evaluate information, and propose rational solutions. Furthermore, research by Putri (2023) and Suryawan (2023) suggests that the effectiveness of the PBL model depends on both the teacher's role and the model itself. When inquiry is conducted with open-ended questions and reflective guidance, students show significant improvements in analysis and synthesis. Therefore, PBL does not automatically develop critical thinking skills; instead, it requires systematic pedagogical support.

PBL is often combined with other learning approaches and technologies. According to research by Latifah (2024), the combination of Flipped Classroom and PBL has been shown to increase student participation and conceptual understanding. This is because the problem exploration phase begins after students have gained an initial understanding of online learning. Students are better prepared to speak and analyze critically in class in the two-way learning environment created by this model. Conversely, Rahmawati et al. (2023) combined the STEM approach with the PBL method. They found that the combination resulted in improved critical and creative thinking skills. Students not only have the ability to solve problems, but they can also create innovative solutions by linking ideas from various fields. Sarida (2023) used Android-based media to add a technological dimension to problem-based learning in elementary schools. The results showed that the use of digital media increased the context of students' investigations and helped them think independently, which is an important component of critical thinking.

Analysis across studies showed several factors that consistently influenced the success of PBL implementation in improving students' critical thinking skills, namely: (1) Problem quality (contextual and open-ended problems are more effective in stimulating critical reasoning) (Lestari et al., 2024). (2) The role of the facilitator (teacher's scaffolding): teachers need to provide reflective guidance and high-level questions (Putri, 2023; Suryawan, 2023). (3) Collaboration and social interaction, namely group work, encourage argumentation and verification of ideas among students (Nafiah, 2024). (4) Learning motivation, which is intrinsic motivation, has a strong influence on the depth of analysis and student persistence in the PBL process (Antara et al., 2023). (5) Technology utilization – the integration of digital-based learning technologies strengthens students' exploratory and reflective activities (Sarida, 2023). Thus, the effectiveness of PBL is not only determined by its mechanical application, but also by the implementation context, the supportive learning environment, and the readiness of teachers and students.

Furthermore, this study identified several open research gaps. Most studies have shown that PBL is effective; however, many have focused on cognitive aspects, such as synthesis and analysis. Metacognitive aspects such as evaluative and reflective skills are still rarely studied. Furthermore, there has been limited research on the application of PBL in digital project-based or interdisciplinary learning contexts, both of which have significant potential to enhance critical thinking skills in the digital education era. Therefore, further research is needed to develop digital PBL models or PBL-STEM Technology integration that focuses on comprehensively evaluating critical thinking skills. The SLR findings support the conclusion that the problem-based learning (PBL) approach is effective.

CONCLUSION

Based on a comprehensive analysis of eight SINTA 2-indexed articles and relevant supporting literature, it can be concluded that the problem-based learning (PBL) model consistently demonstrates a high level of success in improving students' critical thinking skills across various educational levels and subjects. PBL is crucial for creating a student-centered learning environment. In this environment, students are asked to develop hypotheses, analyze data, identify problems, and formulate logical, evidence-based solutions. Higher-order thinking skills are enhanced through this process, particularly critical analysis, evaluation, and reflection. The Effectiveness of PBL on Critical Thinking, in which all articles demonstrate that the use of PBL can significantly improve students' critical thinking skills. Students' abilities to analyze, infer, evaluate arguments, and connect concepts have improved with PBL. Therefore, it can be concluded that Problem-Based Learning (PBL) is a useful learning model for improving students' critical thinking skills in the 21st century. However, to be effective, contextual learning design, teacher adaptability, and the integration of technology and innovative learning approaches are necessary. To determine the long-term impact of PBL implementation on students' development of critical thinking, further research with a long-term design is needed. This will enable a better understanding of how PBL impacts students' psychological aspects and facilitate the exploration of the affective and metacognitive components of critical thinking.

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