

Enhancing Elementary to High School Students' Critical Thinking Skills through Problem-Based Learning (PBL)

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Abstract. Critical thinking is an essential 21st-century skill for students from elementary to high school. However, various studies show that this ability is still relatively low. Problem-Based Learning (PBL) presents itself as a learning solution that can develop students' critical thinking skills in problem-solving. A thorough literature analysis will be used in this study to investigate how well the PBL approach develops students' critical thinking skills. Data were gathered from 20 scientific articles published between 2020 and 2025, indexed by Google Scholar, and then evaluated. The results of the study show that PBL can help students from elementary school through high school develop their critical thinking skills. This study emphasises how vital PBL is as a proper active learning strategy for developing students' critical thinking skills.

Keywords: *Critical Thinking; Active Learning; Problem-Based Learning*

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Introduction

Students need critical thinking skills to adapt and compete worldwide in an era of fast scientific and technological advancement. Students must learn to confront 21st-century difficulties, often known as 21st-century talents. Communication, teamwork, critical thinking, creativity, character, and citizenship are among the skills required (Triana & Amelia, 2024). Critical thinking is one of the most commonly emphasised talents.

When reacting to or addressing problems, students are encouraged to use critical thinking skills, which are cognitive talents (Juliyantika et al., 2022). When it comes to mental tasks like issue solving, decision making, and hypothesis analysis, critical thinking involves methodical thought processes. Pupils who possess the ability to think critically can solve problems by coming to appropriate and reasonable conclusions.

Several studies have found that kids' critical thinking skills remain low. Zakiyah et al. (2022) found that students had a pre-cycle average score of 49.38 and a critical thinking percentage of 12.5%, indicating a lack of mastery of basic thinking skills. Similarly, Nur Huda and Abduh (2021) found that traditional learning techniques in elementary schools during the pandemic resulted in a poor degree of critical thinking competence (68.96%). The poor degree of critical thinking skills among pupils is a significant problem for educators working to improve students' thinking skills.

Learning can be implemented using the Problem-Based Learning (PBL) technique. The PBL technique is a learning strategy that involves assigning tasks for students to tackle independently or in groups based on pre-existing difficulties. As a result, pupils are capable of reasoning profoundly or critically when solving problems using strategies based on their understanding (Said et al., 2023). PBL is a learning method that uses real-world scenarios as a setting to teach students subject-specific knowledge and concepts, as well as critical thinking and problem-solving skills. The PBL technique emphasises problem-solving and gives students more opportunities to be active and capable of finding solutions to current challenges.

PBL implementation is an alternative to improving students' critical thinking skills by engaging them in learning because the information and concerns covered are real-world problems (Prasetyo and Kristin, 2020). The PBL technique assists students in actively solving

difficulties encountered during the learning process, while also serving as a learning model for developing critical thinking skills and allowing students to construct their knowledge.

The PBL approach has been shown in numerous studies to improve pupils' critical thinking skills. Students' critical thinking skills improved by 0.61% to 18.15%, per Saputri's (2020) research. Furthermore, Kartikasari et al. (2021) found that the PBL paradigm improved the critical thinking skills of fourth-grade children, as demonstrated by their average scores of 71.4 in the second cycle and 62.143 in the first.

Cahyaningtyas and Sutarni (2024) found that the classroom action approach method used on seventh-grade junior high school students increased critical thinking skills indicators from 66% to 88% following two cycles of PBL deployment. Furthermore, Andeline et al. (2023) at SMA Negeri 1 Porong discovered that implementing PBL boosted students' critical thinking skills from 71.53% in the first cycle to 91.67% in the third cycle.

Several researchers have researched the Problem-Based Learning (PBL) approach in an effort to improve critical thinking skills in students from elementary to high school levels, and the results show that the Problem-Based Learning (PBL) model is effective in increasing or improving students' critical thinking skills. Based on this description, this study will delve deeper into the impact of Problem-Based Learning (PBL) on strengthening students' critical thinking skills at the elementary and high school levels using a literature review technique.

Methods

The study applies a Systematic Literature Review (SLR) to investigate the connection between students' critical thinking skills and problem-based learning (PBL). Because it allows researchers to thoroughly and methodically investigate a wide range of empirical study findings, the SLR methodology was selected. The review method, which includes steps like information synthesis, identification, selection, and feasibility testing from several pertinent scientific publications, is guided by the PRISMA concept.

The first step was to identify publications using two academic databases: Google Scholar and ScienceDirect. The keywords "Problem-Based Learning" and "critical thinking" were used in the search, with a publication date range of 2020 to 2025. The articles examined were confined to Indonesian or English-language publications that had undergone peer

review, were aimed at elementary to secondary students (SD-SMA), and employed a quantitative or experimental method.

Following the search, papers were picked by reading their titles, abstracts, and significant content to ensure relevancy and completeness. Articles that did not fulfil the inclusion requirements, such as opinion pieces, non-empirical essays, duplicates, or missing full text, were omitted from the analysis. This approach produced 15 papers that matched all requirements and served as primary sources for the study.

Information about the research design, participant count, data collecting and analysis methods, and significant findings pertaining to the connection between PBL and critical thinking were extracted from each article using content analysis. To detect broad trends, variations, and essential conclusions from the examined research, a thematic synthesis of the data was carried out. Choosing papers from peer-reviewed, indexed publications and making sure all sources were current and highly pertinent to the study's topic helped to preserve the study's data validity.

Results

Based on the analysed literature sources, 20 articles served as sources for this literature review. The publication year of the articles related to the Problem-Based Learning (PBL) method and students' critical thinking skills between 2020 and 2025 is shown in Table 1.

Table 1.
Article Review

No	Author (Year)	Title	Method	Results
1	Nurbaya, S. (2021)	Improving Critical Thinking and Problem Solving Skills Through the Problem Based Learning (PBL) Model in Thematic Learning with Mathematics Content for Class VI of SDN 19 Cakranegara	Classroom Action Research	Students' critical thinking skills improved by 9.46%, from an average of 61.15 to 71.33. In the meantime, the ability to solve problems improved from 62.33 to 69.5 (11.5%). As a result, sixth-grade pupils at SDN 19 Cakranegara were able to develop their critical thinking and problem-solving

				skills through the model's application.
2	Dewi, DT (2020)	Implementation of Problem-Based Learning to Improve Students' Critical Thinking Skills	Classroom Action Research	The process of learning is greatly impacted by the Problem-Based Learning model. The use of the Problem-Based Learning paradigm in APBN and APBD classes has been well welcomed; learning completion has increased from 50% in cycle I to 87.5% in cycle II, and students' critical thinking skills as well as teacher and student engagement have improved.
3	Aini, et al. (2020)	Improving Critical Thinking Skills by Using the Problem-Based Learning (PBL) Model in Grade IV Students of MI Al-Falah	Classroom Action Research	According to this study, grade IV pupils at MI Al Falah Teratak now have better thinking skills. They attained 50% classical mastery in cycle I. The mastery then rose to 90% in cycle II.
4	Misla., & Mawardi. (2020).	The Effectiveness of PBL and Problem Solving in Elementary School Students in Terms of Critical Thinking Skills	Quasi Experiment Using a Nonequivalent Control Group Design	Group 1 used the Problem-Based Solving learning model, and their average score was 86.11; group 2 used the Problem Solving learning model, and their average score was 72.88. 13.11 was the difference between the two groups. In comparison to the problem-solving approach, it can be said that the problem-based learning approach helps students develop their critical thinking skills.

5	Setyawan, M., & Henny, DK (2021)	The Effect of Problem-Based Learning on Critical Thinking in Elementary School Students	Meta Analysis	The Problem-Based Learning method is effective and can be applied to the learning process. It can help pupils improve their critical thinking skills.
6	Huda, AIN, & Muhammad, A. (2021)	Improving Students' Critical Thinking Skills Through Problem-Based Learning Model in Elementary School Students	Classroom Action Research (CAR)	The average score of fifth-grade students at SD Negeri 3 Pandean increased from 53.7 in the pre-cycle to 85.36 in the second cycle, and the percentage of students who completed their learning increased to more than 75%, indicating that the implementation of the Problem-Based Learning (PBL) model significantly improved their critical thinking skills and learning activity.
7	Haryanto & Kusmiyati. (2020).	Analysis of the Application of the Problem-Based Learning Model in Improving Critical Thinking Skills of Elementary School Students	Literature Study	Students' analytical skills have been shown to improve with the use of the PBL learning approach. Students that possess good analytical and critical thinking skills should be able to answer problems accurately and critically.
8	Rauf, et al., (2022).	The Influence of Problem-Based Learning Model on Students' Critical Thinking Skills	Quasi-Experimental Design	In class V at SDN 77 Kota Tengah, Gorontalo City, the Problem-Based Learning Model has an impact on the critical thinking skills of the students studying the science topic of heat.

9	Husna, Hayatul. (2023).	Application of the PBL (Problem-Based Learning) model in the constructivist theory approach to improve critical thinking skills	Qualitative Research Through Literature Study	According to constructivist theory, students' critical thinking skills can be enhanced by using the PBL (Problem-Based Learning) model.
10	Musa'ad, F., & Suparman. (2023).	Development of Problem-Based Learning-Based E-Modules to Stimulate 21st-Century Critical Thinking Skills	Research Research And Development (R&D)	In order to develop students' critical thinking skills, this study creates an e-module based on problem-based learning. Its validity, usefulness, and efficacy have been evaluated, and the results show that the e-module used improves students' critical thinking skills, as evidenced by the average student score of 85, which is higher than the KKM score of 70.
11	Yu, Ling., & Zuhana, M.Z. (2023)	The Critical Thinking Oriented Adaptations of Problem-Based Learning Models: A Systematic Review	Systematic Review Method with PRISMA Approach (Preferred Reporting Items For Systematic Review And MetaAnalyses).	It was discovered from the analysis of 20 linked articles that problem-based learning can enhance students' learning capacities. Activities that focus on developing critical thinking skills, integrating digital technology, incorporating alternative pedagogical approaches, using specialised critical thinking tools, and combining PBL with specialised discipline knowledge are the five categories of strategies that were found to be employed to adapt the

				Problem-Based Learning method.
12	Susilawati, S., & Triyo, S. (2023)	Problem-Based Learning Model I Improving Critical Thinking Ability of Elementary School Students	Research is Classroom Action With Qualitative and Quantitative Approaches	Cycle I implementation yielded 80.73% of students in the very good group, which increased to 91.76% in cycle II, and 85.09%, which increased to 92.96% in cycle II. In order to enhance critical thinking in integrated theme learning in class IV SDN II Weringinom Poncokusumo Malang, East Java, Indonesia, problem-based learning is used.
13	Aisyah, FN, & Gumala, Y. (2025).	Implementation of the Problem-Based Learning (PBL) Model as an Effort to Improve Critical Thinking Skills of Elementary School Students: Literature Review	Literature Review	It has been demonstrated that the Problem-Based Learning paradigm is a successful, efficient, and beneficial way to help elementary school pupils develop their critical thinking skills. In addition to giving students the chance to answer a variety of problems, this approach promotes critical and analytical thinking in addition to active participation in the learning process.
14	Yulisriyant i, Y. (2024).	Implementation of the Problem-Based Learning (PBL) Model to Improve Students' Critical Thinking Skills	Qualitative with Classroom Action Research (Ptk) Approach	An increase in the percentage of critical thinking indicators from the reasonably good category to the good category indicates that the use of the Problem-Based Learning (PBL) paradigm enhances the

				critical thinking skills of grade IX students studying science.
15	Abdullah, & Munawwa Roh, F. (2024).	Problem-Based Learning to Improve Students' Critical Thinking Skills	Qualitative with Contextual Case Study Approach	Applying the Problem-Based Learning (PBL) paradigm, which encourages students to recognise and comprehend real-world problems and collaborate to find answers methodically, can help students enhance their critical thinking skills.
16	Amalia, IR, & Dewi, NR (2024).	Analysis of Problem-Based Learning Model to Improve Students' Critical Thinking Skills	Literature Review	It has been demonstrated that using STEM-based teaching resources in conjunction with the Problem-Based Learning (PBL) approach enhances students' critical mathematical thinking skills, resulting in classical mastery. The implemented learning was well received by the students.
17	Aritonang, PSFB, Amelia, R., Afianto, R., Amalia, S., & Fitrianna, AY (2024).	Implementation of Problem-Based Learning (PBL) in Improving Students' Critical Thinking Skills in Elementary Schools	Qualitative with Classroom Action Research (Ptk) Approach	PBL considerably enhanced the critical thinking skills of fifth-grade primary school pupils. The improvement in scores following two cycles of classroom activity demonstrated this. Pupils improved their ability to solve problems and comprehend the subject matter thoroughly.
18	Nursa'ada h, D., Usman,	Implementation of Differentiated	Quasi-Experimental	The study's findings demonstrated that fifth-

	AT, & Anisah, AS (2025)	Learning with the PBL Model to Improve Students' Critical Thinking Skills in Science Subjects	Method with Nonequivalent Control Group Design	grade MI students' critical thinking skills were considerably enhanced by PBL-based differentiating instruction. The Mann-Whitney test produced a significance level of 0.001, and the average critical thinking score fell into the good category, demonstrating the efficacy of the PBL paradigm in comparison to traditional techniques.
19	Robbani, H. (2025)	Developing Critical Thinking Skills Through Problem-Based Learning	Literature Review	Critical thinking skills, especially in analysis, evaluation, and solution building, are greatly enhanced by PBL. The PBL group's scores increased by 25%, while the control group's scores increased by 10%, according to studies. Students' ability to collaborate in groups also improves their critical thinking skills.
20	Husna, A., Ilmi, N., & Gusmaneli. (2025)	Problem-Based Learning Strategies to Improve Students' Critical Thinking Skills	Literature Study with a Qualitative Approach	PBL has been shown to be successful in enhancing students' critical thinking skills through reflection, group discussions, and problem identification from the real world. Along with encouraging autonomous and imaginative learning, this approach highlights how applicable the subject matter is to everyday situations. Instead of giving pupils

straight answers, the instructor facilitates their problem-solving process.

Results from the research on using Problem-Based Learning (PBL) techniques to help students improve their critical thinking skills are shown in Table 1. The results of this research show that a supportive learning environment, including conversations, questioning, and material analysis, can help students enhance their skills.

Discussion

Teaching critical thinking from an early age is crucial. A survey of 20 national and international journals found that PBL, particularly in elementary and high school, can improve students' critical thinking skills. According to Husna (2023), this learning paradigm involves students in learning activities that emphasise real-life situations as a foundation for learning concepts and knowledge through critical thinking skills.

The instructor serves as the primary facilitator when putting Problem-Based Learning (PBL) into practice, helping students use critical thinking to solve issues. Rosidah (in Aisyah & Yosi, 2025) states that there are five processes involved in incorporating Problem-Based Learning (PBL) into educational activities:

1. Orienting or focusing students on the problem. The teacher explains the learning objectives and needs, and acts as a motivator so that students can be interactive in solving problems.
2. Educators manage students in learning that is correlated with problem-solving.
3. Conducting guided investigations. Students receive guidance and direction from educators.
4. Developing and presenting work. Students design and prepare presentations of their work through problem-solving procedures with guidance from educators.
5. Analysing and assessing problem-solving procedures. Conduct evaluations and reflections on the learning that has been implemented with the guidance of educators.

There are benefits and drawbacks to the problem-based learning (PBL) approach. One drawback is that it might take a lot of time, particularly when forming groups. Therefore, it's essential to explain the objectives of the learning process to students to ensure effectiveness.

According to Aini et al (2020), the advantages of using the Problem-Based Learning (PBL) model to improve students' critical thinking are:

1. Students are urged to apply their problem-solving skills in practical settings,
2. Students can construct their knowledge through learning activities,
3. Learning focuses on problems so that students do not need to learn unrelated material.
4. Scientific activities occur in students through group work
5. Students are accustomed to using sources of knowledge, whether from libraries, the internet, interviews or observations.
6. Students can assess their learning progress.
7. Students can carry out scientific communication in discussion activities or presentations of the results of their work.
8. Learning difficulties

According to Husna (2023), critical thinking is the process of identifying several presumptions and integrating existing knowledge to extract relevant information for reflectively generalising mathematical problems. This process includes solving problems, drawing conclusions, using computation skills, and making decisions. I concur that critical thinking skills are essential since they enable one to think clearly, respond intelligently to problems, and arrive at reasoned conclusions about what to do or believe (Susilawati et al., 2020). Therefore, it is crucial to start critical thinking skills early in life.

The problem-based learning (PBL) methodology has been shown to enhance students' critical thinking skills. Nonetheless, a number of scholars highlight that the teacher's function as the primary facilitator is crucial to the Problem-Based Learning (PBL) model's efficacy (Setyawan & Henny, 2021; Husnae2021).

Although more research is required to determine how the Problem-Based Learning (PBL) model can be modified to accommodate the limited time and resources available in schools, it can function as an alternative in the learning process that can enhance students' critical thinking skills (Aini et al. 2020; Aritonang et al. 2024; Nurbaya, 2021).

Conclusion

Students' critical thinking skills have been shown to develop from elementary school through high school when Problem-Based Learning (PBL) is applied consistently. According to an analysis of 20 scholarly publications from 2020 to 2025, problem-based learning, or PBL, fosters an engaging and contextual learning environment that pushes students to approach issues methodically, analytically, and reflectively. Numerous research types, including literature reviews, experiments, and classroom action research, have demonstrated notable gains in students' critical thinking skills. According to these results, Problem-Based Learning (PBL) is a valuable and pertinent teaching strategy for fostering 21st-century skills, especially critical thinking, and it plays a crucial role in the advancement of educational psychology and practice.

Author's Declaration

Authors' contributions and responsibilities

- ☒ The authors made substantial contributions to the conception and design of the study.
- ☒ The authors took responsibility for data analysis, interpretation and discussion of results.
- ☒ The authors read and approved the final manuscript.

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Availability of data and materials

- ☒ All data are available from the authors.

Competing interests

- ☒ The authors declare no competing interests.

Additional information

No additional information is provided for this research.

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