IMPLEMENTATION OF PROBLEM BASED-LEARNING TO IMPROVE CRITICAL THINKING: A SYSTEMATIC LITERATURE REVIEW

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Article Info	Abstract
	Problem-Based Learning (PBL) has emerged as a crucial pedagogical approach for fostering students' critical and creative thinking skills. However, its implementation often faces challenges, such as limited resources, insufficient teacher training, and the complexity of designing meaningful problem scenarios. This study employed a Systematic Literature Review (SLR) guided by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework to examine the application of PBL in enhancing students' critical thinking skills. An initial search yielded 342 articles, which were screened through title and abstract review, followed by full-text assessment based on predefined inclusion and exclusion criteria. After a rigorous selection process, 9 articles that met the criteria were finally analyzed in detail. The review revealed that the majority of research on PBL and critical thinking was conducted in Indonesian high school contexts. Findings consistently indicated that PBL significantly improves students' critical thinking, creative thinking, and engagement in learning activities. Studies demonstrated that when PBL is effectively integrated, students exhibit stronger analytical abilities, enhanced problem-solving skills, and increased active participation. These findings underscore the importance of integrating PBL as a core teaching methodology, especially in preparing students to meet the complex demands of a globalized and interconnected world. Despite implementation challenges, PBL offers significant potential to reshape traditional education and foster future-ready learners equipped with essential higher-order thinking skills encourage motivation and achieve optimal learning outcomes.

INTRODUCTION

Learning in the 21st century is an educational process that assists students in cultivating skills, abilities, and comprehension to equip them for competition in the job market. Asio and de Dios (2019) demonstrated the attributes of a well-qualified educator, highlighting the importance of having an innovative approach to teaching students. In today's world, educating students is different from how it was decades ago. High school students can subject teachers to various forms of degradation. Therefore, it is essential to offer a solid and analytical method of imparting knowledge to learners (Mercy et al., 2020). As a result, a student with strong critical thinking skills will have an easier time understanding the concepts in the material and will be more sensitive to issues (Risang Baskara, 2023).

Problem-oriented learning is a contemporary educational approach that fosters critical thinking abilities. PBL engages students directly and actively, leading to more effective learning than methods that merely transmit information (Eka Putri & Kartikowati, 2023). Razak Abdul Azila et al. (2022) described a contemporary teaching method that educators can use to foster students' critical thinking skills and enhance learning outcomes is the problem-based learning (PBL) approach. Problem-based learning helps students enhance critical thinking, develop skills, and analyse problems more effectively. Fadilla et al (2021) indicated that problem-based learning represents a breakthrough in education as it effectively enhances students' cognitive skills through a structured group or team approach, enabling learners to strengthen, refine, assess, and progressively advance their thinking abilities. The ability to think critically is essential for achieving success in contemporary life, serving as a means to tackle rapid and complex changes (Erni, 2021). Enhancing critical thinking abilities can be achieved via problem-based learning, which can strengthen, refine, assess, and cultivate thinking skills consistently.

This mindset or trait is communicated both conceptually and contextually. Teaching critical thinking skills in depth is essential for students to have a better understanding of the conditions of their living environment. The ability should be cultivated from the formulation of learning objectives that are based on the environmental conditions around them (Amin et al., 2020). The learning goals, as stated by Zamroni et al. (2020), aim to enable students to: (1) clarify the concept of environment; (2) assess the quality of the environment; (3) evaluate environmental degradation; (4) identify appropriate measures to address environmental issues; and (5) formulate examples of effective actions for environmental conservation and sustainable development. From the description, one can conclude that the variable of critical thinking skills is directly related to the environmental attitude. Students possessing strong critical thinking abilities are believed to have positive environmental attitudes. Critical thinking abilities have turned into a vital component of educational objectives to be accomplished in the academic realm, as outlined in Minister of Education and Culture Regulation No. 73 on problems-based learning 2013 regarding the Indonesian National Qualification Framework (KKNI). Analytical thinkers with strong critical thinking skills have been nurtured, and traditional education systems from a high (Ahmad & Sukiman, 2019).

The problem-based learning (PBL) model utilizes actual issues faced in the environment to facilitate the acquisition of knowledge and concepts by fostering critical thinking and problem-solving skills. PBL is an interactive procedure (Nadeak Bernadetha & Naibaho Lamhot, 2020). Uliyandari et al. (2021) stated that learners gather knowledge by constructing the reasoning behind all the information they possess and from everything acquired through

interactions with other individuals. With PBL, learners are anticipated to address challenges using multiple potential solutions and to recognize the reasons behind current issues.

The application of the development method of critical capacities—namely, problem-based learning—will be the main emphasis of this research. One possible question is whether problem-based learning effectively aids participants in enhancing or utilizing their critical thinking skills.

Numerous of researches have shown that using Problem-Based Learning, or PBL, tends to have the same kind of results. For example, Istiqomah and colleagues (2022) looked at how PBL, specifically when used in a lab setting to study how *E. coli* and *Candida albicans* interact, affected students' ability to think critically. They found that PBL definitely helped students think more critically. Along the same lines, Sri Kuwita Gandi and others (2021) explored how PBL, when mixed with STEM subjects, impacted critical thinking skills. Their data, backed up by a T-test, clearly showed that students got much better at critical thinking. Even when it comes to high schoolers, PBL seems to work well. Rahmawati and her team (2023) combined PBL with a method called "Two Stay Two Stray" to teach students about environmental changes. They saw a big jump in student motivation, with everyone feeling more engaged by the end of the study. Santosa and colleagues (2023) tried something interesting: they mixed Problem-Based Learning (PBL) with bioentrepreneurship in biotech classes, and it really grabbed the students' attention and kept them involved. Over at a vocational high school, Nur and Ikhsan (2024) used STEM-integrated PBL in science classes about substances and how they change, which helped students get better at solving problems and made them more eager to learn. Wahyuni and Sari (2023) also gave PBL a shot when teaching green chemistry, and the average student score went up from 71.61% to 86.96%. Another school, SMA Negeri 2 Mataram, combined PBL with Culturally Responsive Teaching (CRT) in chemistry lessons about colligative properties, and the result was students participating more in class. Because so many studies show that PBL is really good for students—especially when it comes to boosting their critical thinking, problem-solving skills, motivation, and grades—this detailed review is all about taking a deeper look at how Problem-Based Learning is used. In particular, this aims to assess how well Problem-Based Learning (PBL) works to boost students' understanding of the material, their critical thinking abilities, and their overall academic success.

METHODS

This systematic review uses the PRISMA method (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) to find, screen, and analyze relevant studies about using Problem-Based Learning (PBL) in high schools. PRISMA offers a clear and repeatable process to make sure we include high-quality and relevant research.

Search Strategy and Data Sources

The initial search for relevant studies yielded a total of 342 articles, primarily sourced from the Mendeley Library database. To obtain precise and targeted results, we applied specific search phrases built around carefully selected keywords, including "Problem-Based Learning," "Critical Thinking," "High School," and "Indonesia." These keywords were strategically combined using Boolean operators (AND, OR) to refine the search results. One example of a search string used was ("Problem-Based Learning" OR "PBL") AND ("Critical

Thinking") AND ("High School") AND ("Indonesia"). This search strategy was deliberately designed to focus on journal articles that explored the use of PBL within the context of Indonesian high schools, with particular attention to its impact on students' critical thinking skills.

To determine which articles would be included in the systematic review, we established clear inclusion and exclusion criteria. The inclusion criteria (IC) required articles to be published between 2020 and 2024, written in either English or Bahasa Indonesia, and published in peer-reviewed, reputable journals. Additionally, the studies had to specifically investigate the use of Problem-Based Learning in high school settings and examine its effects on students' critical thinking skills or learning outcomes within the Indonesian education system. Conversely, the exclusion criteria (EC) eliminated studies that did not involve high school students, articles from non-educational journals (such as those focusing solely on medicine or technical fields), research limited to higher education or non-traditional educational environments, and any studies that were inaccessible in full text or lacked sufficient methodological details.

The inclusion and exclusion criteria are outlined in Table 1 below.

Table 1.

Inclusion and exclusion criteria for the article selection

| Criteria	Inclusion	Exclusion
Document Type	JOURNAL	Other's Publication
Period	2020-2024	Outside Range
Accessibility	Open Publication	Restricted or paywalled
Population	Senior High School students	Elementary School or Students from other educational levels
Publication Language	Publication in English and Indonesian	Publication in other languages

Screening and Selection Process

The process of identifying the most relevant articles for this study was carried out meticulously. We began by screening the titles and abstracts of 342 journal entries, which allowed us to narrow the pool down to 36 potentially eligible articles. To ensure a thorough evaluation, we then conducted a full-text review of 22 articles, assessing each one against our predefined inclusion and exclusion criteria. After this rigorous selection process, we identified 9 articles that precisely matched our focus. These studies directly explored the impact of Problem-Based Learning (PBL) on the development of critical thinking skills among high school students in Indonesia.

Following the application of these inclusion and exclusion criteria as mentioned in Table 1, a systematic screening process was conducted to narrow down the initial pool of articles. The selection procedure involved several stages, including title and abstract screening, full-text assessment, and final eligibility evaluation. To illustrate this process clearly, the following

PRISMA flow diagram summarizes the identification, screening, eligibility, and inclusion stages that led to the final set of studies included in this review.

Figure. 1

Reporting Items for Systematic Reviews (Adoption of PRISMA)
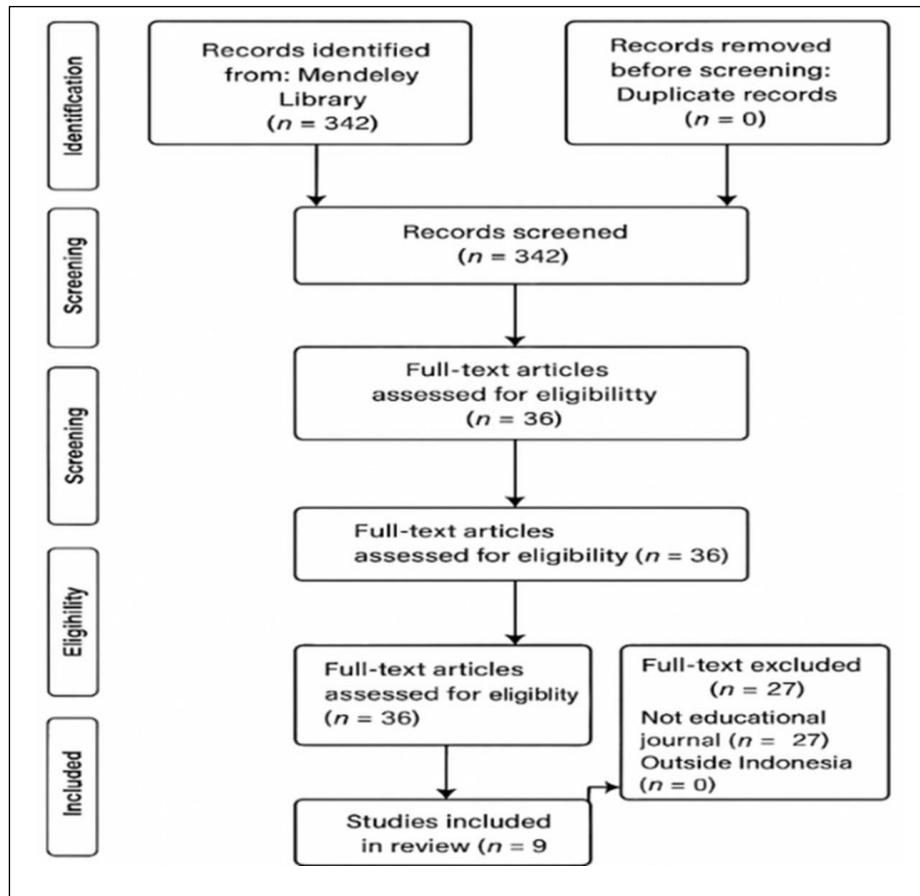
Source: Researcher Process (2024)

This well-organized approach guarantees that the final collection of articles delivers concentrated, pertinent, and top-tier insights into how Problem-Based Learning is put into practice and how well it works within Indonesia's high school educational framework.

FINDINGS

The following table (Table 2) presents a systematic review of selected studies that have implemented PBL approaches to improve students' critical thinking skills. Each entry summarizes the study's basic information, research questions, methods, and key findings, providing a comprehensive overview of the current trends and outcomes in this area of educational research. Through this synthesis, the table highlights the consistent positive impact of PBL methodologies and offers insights into best practices for educators aiming to promote critical thinking in contemporary learning environments.

Table 2.

Systematic Review Studies

No	Name, Year	Title	Research Question (s)	Research Methods	Findings
1.	Saphira and Prahni (2022)	Profile of Senior High School Students' Critical Thinking Skills and The Need of Implementation PBL Model Assisted by Augmented Reality Book	1. What is the profile of senior high school students' critical thinking skills in physics learning, specifically on electromagnetic material? 2. What is the need for the implementation of the Problem-Based Learning (PBL) model assisted by Augmented Reality (AR) book to improve students' critical thinking skills?	A total of 190 high schools' students from Surabaya were involved in this pilot study. CTS assessments, student questionnaires, and teacher and student interviews were used to collect data. Qualitative analysis was carried out to extract the details for patterns and insights concerning the critical thinking skills of students.	Studies show many high school seniors struggle with critical thinking, especially interpretation and evaluation, due to lecture-based teaching. However, active methods like problem-based learning, enhanced with tools like AR books, can significantly boost these skills through more engaging and effective instructional strategies.
2.	Hasanah Idiatul Siti et al., (2021)	Pengembangan Perangkat Pembelajaran Fisika Berbasis Masalah Untuk Meningkatkan Kemampuan Berpikir Kritis	How effective is the developed problem-based physics learning material in improving students' critical thinking skills?	Developing and deploying problem-based learning tools explicitly for high school physics constitutes the primary objective of this study. Several classroom cycles were implemented to test these tools, and evidence was collected by means of feedback, observational checklists, and student assessments.	Developed problem-based physics materials for harmonic vibration were valid, efficient, and effective in improving students' critical thinking (medium gain). Validated components (syllabus, lesson plans, worksheets, assessments, videos) received positive student and feasibility ratings, demonstrating the materials' success.
3.	Umar (2023)	Meningkatkan Kemampuan Berpikir Kritis Siswa Melalui Penerapan Problem Based Learning Materi Pengolahan Makanan Khas Daerah Yang Dimodifikasi	How effective is the application of Problem Based Learning (PBL) on modified local food processing material in improving students' critical thinking skills?	Implementing PBL across two cycles with 30 high school students, this Classroom Action Research used observations and essays to assess critical thinking. Rooted in regional food processing industry changes, the study indicates PBL's potential to develop these skills.	Applying PBL significantly boosted students' critical thinking in modified local cuisine processing. Classroom Action Research showed notable improvement across cycles, evident in increased engagement and test scores. The study concludes PBL is an effective method for enhancing critical

					thinking skills in this subject.
4.	Oktiana R et al., (2023)	Validity of Video- Assisted Problem- Based Learning Tools to Improve Critical Thinking Ability	Are the developed video-assisted problem-based learning tools valid for improving students' critical thinking ability?	Research and development (R&D) is the methodology employed, with the 4D model design consisting of define, design, develop, and disseminate. The method of data collection employed a validation sheet that was evaluated by three expert validators and three practitioner validators, and the percentage of validity was then calculated	The study confirms the strong validity of the developed video-assisted problem-based learning tools for enhancing critical thinking. Professional evaluators deemed the resources relevant, precise, and appropriate for educational use, indicating their potential for effectively developing students' critical thinking abilities in learning environments.
5.	Dewi (2020)	Penerapan Problem Based Learning untuk Meningkatkan Kemampuan Berpikir Kritis Siswa	How effective is the application of Problem Based Learning (PBL) in improving students' critical thinking skills?	The study used two cycles of planning, acting, observing, and reflecting. Data was collected via a post-test to assess critical thinking and observation sheets to track teacher/student activities and student responses to the Problem-Based Learning model implementation.	Implementing PBL significantly improves students' critical thinking. Increased engagement and higher exam scores demonstrate this enhancement. PBL fosters active learning and problem-solving, making it an effective approach for developing crucial cognitive skills.
6.	Hasanah, Z. et al., (2021)	Implementasi Model Problem Based Learning Dipadu LKPD Berbasis STEM untuk Meningkatkan Keterampilan Berpikir Kritis pada Materi Pencemaran Lingkungan	How effective is the implementation of the Problem Based Learning (PBL) model integrated with STEM-based student worksheets (LKPD) in improving students' critical thinking skills on the topic of environmental pollution?	This study aims to improve students' critical thinking skills by using the PBL learning model combined with STEM-based worksheets on environmental pollution conception class 10th SMA Negeri Bireuen district.	Integrating PBL with STEM-based worksheets significantly boosts students' critical thinking about environmental pollution. This approach actively engages students in problem-solving, enhancing their analytical, evaluative, and creative skills. The research confirms this integration as an effective strategy for improving critical thinking on environmental issues.
7.	Widiastuti et al., (2023)	Implementing Problem-based Learning to Develop Students' Critical and	How does the implementation of Problem-Based Learning (PBL) affect the development of students' critical and	Data on PBL implementation was gathered using a descriptive research design. The data gathering included conducting interviews,	PBL effectively enhances students' critical and creative thinking. Problem-solving actively engages students in

		Creative Thinking Skills	creative thinking skills?	distributing questionnaires, and observing teachers and students. Selected teachers were interviewed using a semi- structured approach to collect qualitative insights.	assessing information, reviewing solutions, and generating innovative ideas, leading to significant improvements in these cognitive skills. Thus, PBL is a valuable teaching approach.
8.	Dewi Triana (2023)	TRANSFORMASI PENDIDIKAN (Membangun SDM Unggul di Era Society 5.0 untuk Menyongsong Era Revolusi Industri 5.0)	How can education be transformed to build superior human resources capable of thriving in the Society 5.0 era and anticipating the Industrial Revolution 5.0?	The chapter of the book summarizes results from different research and talks featured in a national conference. It examines educational approaches and policies for reshaping higher education, such as implementing initiatives like Merdeka Belajar Kampus Merdeka (MBKM), through qualitative analysis.	Educational reform is crucial for cultivating superior human resources for Society 5.0 and the 5th Industrial Revolution. Traditional methods focusing on memorization are insufficient. Emphasizing critical thinking, creativity, teamwork, and adaptability through technology and innovative teaching is essential to prepare students for the evolving job market and interconnected world.
9.	Yani and Febri (2024)	Peningkatan Kemampuan Berpikir KritisSiswa Kelas VIIMelalui Problem Based LearningBerbasis Tri N	How effective is the implementation of Tri N-based Problem Based Learning in improving the critical thinking skills of seventh-grade students?	This Classroom Action Research likely used pre/post-tests, observations, and work analysis to assess "Tri N"-based PBL's impact on critical thinking. The cyclical approach involved implementing and evaluating the revised PBL strategy using both test scores and qualitative data like discussions and observations.	Implementing Tri N-based PBL significantly boosted seventh-grade students' critical thinking. This integrated approach fostered active engagement in problem-solving, leading to notable skill enhancement. Students reacted positively, and the method proved effective in improving their critical thinking abilities.

The analysis of the nine selected studies in the Table 2 demonstrates a consistent and positive impact of Problem-Based Learning (PBL) on students' critical thinking abilities in Indonesian high school settings. Several studies (e.g., Saphira & Prahni, 2022; Umar, 2023; Dewi, 2020) report that traditional lecture-based methods have limited effectiveness in cultivating critical thinking, particularly in areas like interpretation and evaluation. In contrast, the use of PBL—especially when enhanced with tools such as Augmented Reality books or contextualized materials like local food processing content—encouraged deeper engagement and better performance in post-assessments. Students exposed to PBL were found to exhibit increased levels of analysis, reflection, and evaluation, indicating the method's potential in transforming passive learners into active problem-solvers.

The integration of PBL with other instructional tools also emerged as a key theme in enhancing critical thinking. For example, Hasanah et al. (2021) and Oktiana et al. (2023) demonstrated that combining PBL with STEM-based worksheets and video-assisted learning tools significantly improved the relevance and effectiveness of classroom experiences. These studies highlighted how structured resources—when aligned with the PBL framework—can scaffold students' reasoning processes and support the development of transferable skills. Similarly, the research by Yani and Febri (2024) on Tri N-based PBL showed that iterative classroom cycles and reflective learning tasks significantly bolstered students' problem-solving capabilities and confidence in applying critical thinking strategies.

Furthermore, the findings also pointed to PBL's broader educational implications. Widiastuti et al. (2023) and Dewi Triana (2023) emphasized that PBL not only sharpens critical thinking but also fosters creative thinking, teamwork, and adaptability—skills that are essential for navigating the complexities of Society 5.0 and the Industrial Revolution 5.0. These studies advocate for a shift from rote memorization to more dynamic, student-centered approaches that prepare learners for real-world challenges. Overall, the systematic review confirms that PBL is not merely an instructional method, but a transformative educational strategy that supports the cultivation of future-ready learners equipped with the cognitive tools necessary for academic and societal success.

DISCUSSION

After looking at all the information, it's clear that Problem-Based Learning (PBL) is a powerful teaching method that really helps students think critically and creatively. The studies we looked at consistently show that PBL does a great job helping students get better at analyzing problems, coming up with hypotheses, and thinking logically. Even though there were some differences when we compared all nine studies.

For instance, although research by Wahyuni & Sari (2023) and Santosa et al. (2023) emphasized significant gains in test scores and student engagement, a few studies, especially those incorporating culturally responsive teaching or STEM elements, hinted that the advantages of Project-Based Learning (PBL) could vary depending on the situation. In particular, enhancements in critical thinking weren't consistently observed across various classroom settings or among different student groups. This suggests that the effectiveness of PBL may greatly depend on its implementation, the available support structures, and it fits with students' needs.

Furthermore, a close look reveals that although Project-Based Learning (PBL) did boost creative thinking thanks to open-ended assignments and teamwork, putting it into practice wasn't without its hurdles. Many teachers felt they weren't quite ready, and the curriculum itself sometimes felt too rigid. This aligns with what's been seen globally, too; educators across different regions have mentioned struggling to shift to a student-driven approach because they don't feel well-trained enough and lack sufficient backing from their institutions.

Regarding how PBL fostered collaboration, every study saw students interacting, communicating, and working together more. However, how much students actually collaborated differed from class to class. Some classes really took to creating knowledge as a group, while others were less enthusiastic, possibly because they weren't used to being graded on group work. These results are in line with international studies, which highlight the

importance of not just teaching content in PBL but also nurturing group dynamics and interpersonal skills.

These findings hold major significance for researchers worldwide. To start with, this review contributes to the expanding global evidence base demonstrating that Project-Based Learning (PBL) is effective at nurturing essential 21st-century skills, including adaptability, innovation, and critical thinking. Additionally, it highlights the need for tailoring PBL to specific contexts—PBL simply can't be a universal, off-the-shelf solution. Factors like cultural background, a school's preparedness, and the specific subject matter all require careful consideration.

Ultimately, these results call for heightened international cooperation in PBL research, especially in regions like Southeast Asia that haven't been studied as extensively. Conducting cross-cultural comparisons would be incredibly valuable in understanding how to best implement PBL across diverse educational landscapes, potentially paving the way for more resilient and broadly applicable teaching methods.

CONCLUSIONS

PBL activities have been shown to enhance critical thinking skills, creative thinking abilities, and engagement in learning. Students who participated in PBL activities outperformed their peers in conventional lecture-based conditions, identifying central problems better, developing hypotheses, and reasoning analytically. The open-ended nature of PBL allowed students to think out of the box, enhancing their creativity and adaptability. The student-centered nature of PBL raised engagement levels, fostering intrinsic motivation and active participation. Emphasis on teamwork allowed students to develop interpersonal and communication competencies while navigating group dynamics and resolving conflicts. This collaborative environment not only supported critical and creative thinking but also nurtured a sense of shared responsibility and mutual learning. PBL aligns with 21st-century demands on education, increasing students' self-confidence and computational versatility. However, challenges in implementation include teachers' difficulties in shifting from traditional teacher-centered approaches to the facilitative role of the teacher, time-consuming problem design, and resource constraints. The study suggests focused professional development programs and integrating supportive technologies to refine PBL practices.

Acknowledgment

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