



PROBLEM-BASED LEARNING AS A LEARNING STRATEGY: A SYSTEMATIC LITERATURE REVIEW OF ITS EFFECTS ON CRITICAL THINKING AND ACADEMIC ACHIEVEMENT

Pembelajaran Berbasis Masalah Sebagai Strategi Pembelajaran: Tinjauan Literatur Sistematis Tentang Pengaruhnya Terhadap Pemikiran Kritis Dan Prestasi Akademik

✉Wulan Purnamasari¹, Andi Annisa Sulolipu²

^{1,2} Universitas Negeri Makassar

Corresponding Author, wulan.purnamasari@unm.ac.id, Pendidikan Ekonomi, Universitas Negeri Makassar-Indonesia

ARTICLE INFO

Article History:

Received : 22/05/26

Revised form : 26/05/26

Accepted : 31/06/26

Published online : 06/06/26

Keywords:

Educational;

Technology;

Entrepreneurial;

Entrepreneurial

Mindset;

Pedagogical

Kata Kunci

Pendidikan;

Teknologi;

Kewirausahaan;

Pola Pikir Kewirausahaan;

Pedagogis

How To Cite:

Purnamasari W, Sulolipu AA. Problem-Based Learning As A Learning Strategy: A Systematic Literature Review Of Its Effects On Critical Thinking And Academic Achievement. *Journal Research Education Mamminasata*. 2026;1(2):220-227. doi:10.66303/2nbwn661.

ABSTRACT

Problem-Based Learning (PBL) is an innovative learning strategy that places real-world problems as the starting point of the learning process to encourage active student engagement and independence. This study aims to examine and synthesize empirical evidence regarding the effect of PBL on students' critical thinking skills and academic achievement through a systematic literature review approach. The method used refers to the PRISMA guidelines with a literature search conducted in four reputable electronic databases, namely Google Scholar, ERIC, Scopus, and SAGE Journals, covering publications from 2015 to 2024. Of the 214 identified articles, 32 articles met the inclusion criteria and were analyzed using a narrative synthesis method. The review results showed that 81.25% of studies reported that PBL had a significant effect on improving critical thinking skills, while 68.75% of studies reported a positive effect on student academic achievement. The effectiveness of PBL is influenced by four main factors: the quality of problem design, teacher pedagogical competence, student characteristics, and learning time allocation. Inconsistencies in findings across studies were associated with inappropriate assessment instruments and teachers' lack of preparedness as facilitators. This review concludes that PBL is an effective and relevant learning strategy for widespread implementation, with recommendations for ongoing teacher training and the development of a more flexible curriculum to optimize the implementation of PBL at various levels of education.

ABSTRAK

Pembelajaran Berbasis Masalah (Problem-Based Learning/PBL) merupakan strategi pembelajaran inovatif yang menempatkan masalah nyata sebagai titik awal proses belajar guna mendorong keterlibatan aktif dan kemandirian siswa. Penelitian ini bertujuan untuk mengkaji dan mensintesis bukti empiris mengenai pengaruh PBL terhadap kemampuan berpikir kritis dan prestasi akademik siswa melalui pendekatan tinjauan literatur sistematis. Metode yang digunakan mengacu pada panduan PRISMA dengan pencarian literatur dilakukan pada empat database elektronik bereputasi, yaitu Google Scholar, ERIC, Scopus, dan SAGE Journals, mencakup publikasi tahun 2015 hingga 2024. Dari 214 artikel yang teridentifikasi, sebanyak 32 artikel memenuhi kriteria inklusi dan dianalisis menggunakan metode sintesis naratif. Hasil tinjauan menunjukkan bahwa 81,25% studi melaporkan PBL berpengaruh signifikan terhadap peningkatan kemampuan berpikir kritis, sementara 68,75% studi melaporkan pengaruh positif terhadap prestasi akademik siswa. Efektivitas PBL dipengaruhi oleh empat faktor utama, yaitu kualitas desain masalah, kompetensi pedagogis guru, karakteristik siswa, dan alokasi waktu pembelajaran. Inkonsistensi temuan pada sejumlah studi dikaitkan dengan ketidaksesuaian instrumen penilaian dan kurangnya kesiapan guru sebagai fasilitator. Tinjauan ini menyimpulkan bahwa PBL merupakan strategi pembelajaran yang efektif dan relevan untuk diterapkan secara luas, dengan rekomendasi perlunya pelatihan guru berkelanjutan serta pengembangan kurikulum yang lebih fleksibel guna mengoptimalkan implementasi PBL di berbagai jenjang pendidikan.

INTRODUCTION

21st-century education demands a fundamental transformation in the way teachers design and implement learning processes. Critical thinking, problem-solving, collaboration, and communication skills are now key competencies that every student must possess to face the challenges of a rapidly evolving world.¹ Amidst these changes, conventional teacher-centered learning approaches are deemed increasingly inadequate in facilitating the optimal development of these competencies.² Therefore, various innovative learning strategies continue to be developed and researched by educators and researchers worldwide, one of which is Problem-Based Learning (PBL).

Problem-Based Learning (PBL) is a pedagogical approach first introduced at McMaster University's Faculty of Medicine in

Canada in the late 1960s by Howard Barrows.³ This approach places real-world problems as the starting point of the learning process, where students actively identify, analyze, and seek solutions to given problems through collaborative work.⁴ Unlike traditional lecture methods, PBL encourages students to become self-directed learners, actively constructing their own knowledge through investigation and reflection.⁵ The constructivist theory developed by Vygotsky and Piaget serves as the primary philosophical foundation underpinning this approach, where knowledge is actively constructed by individuals through interactions with their environment and peers.⁶

In the context of primary and secondary education, the implementation of PBL has shown promising results in various countries. Several studies report that PBL significantly improves students' critical thinking skills compared to conventional learning methods.⁷

Critical thinking itself is defined as an individual's ability to analyze information objectively, evaluate arguments, and draw logical and well-founded conclusions.⁸ This ability is crucial not only in academic contexts, but also in everyday life and the workplace. In addition to critical thinking, PBL has also been reported to have a positive impact on students' academic achievement, learning motivation, and problem-solving and collaboration skills.⁹

However, research findings on the effectiveness of PBL are not always consistent. Several studies show that the effect of PBL on academic achievement varies depending on the educational level, subject matter, student characteristics, and teacher readiness to implement the model.¹⁰ In some contexts, PBL has been found to be less effective for students with low initial abilities due to the high cognitive load required in the problem-solving process.¹¹ Furthermore, limited learning time and a dense curriculum present real obstacles for teachers in implementing PBL consistently and comprehensively in the classroom.¹²

A significant research gap remains in the existing literature. First, most available systematic reviews focus on higher education contexts, particularly in the medical and health fields, while studies specifically examining the influence of PBL on critical thinking and academic achievement at the primary and secondary levels are still very limited.¹³ Second, there are not many literature reviews that integrate findings from educational contexts in developing countries, including Indonesia, even though the dynamics of PBL implementation in developing countries present different challenges than those in developed countries.¹⁴ Third, the publication period examined in previous systematic reviews generally does not include recent research developments post-COVID-19 pandemic, which has significantly changed the landscape of PBL implementation, particularly in online and hybrid learning formats.¹⁵

Based on these research gaps, this article aims to conduct a systematic literature review to examine and synthesize empirical findings from various published studies on the influence of Problem-Based Learning (PBL) on students' critical thinking skills and academic achievement. Specifically, this review seeks to identify patterns of consistency and

inconsistency in findings across educational contexts, school levels, and subject areas, and explore moderating factors that influence PBL effectiveness. The results of this review are expected to provide meaningful scientific contributions to the development of learning theory and practice, as well as being an evidence-based reference for educators, researchers, and policy makers in designing more effective and relevant learning strategies in the modern education era.

METHODS

This research employed a systematic literature review approach, referring to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines as the primary framework for identifying, selecting, and synthesizing articles.¹⁶ This approach was chosen because it enabled researchers to collect, evaluate, and synthesize empirical evidence in a structured and transparent manner from various relevant literature sources.¹⁷

Search Sources and Strategy

The literature search was conducted systematically through four internationally reputable electronic databases: Google Scholar, ERIC (Education Resources Information Center), Scopus, and SAGE Journals. Keywords used in the search process included: "Problem-Based Learning," "critical thinking," "academic achievement," "instructional strategy," "learning outcomes," and combinations thereof using the Boolean operators AND and OR. The search was limited to articles published between 2015 and 2024 to ensure the relevance and novelty of the findings.¹⁸

Inclusion and Exclusion Criteria

Articles were included if they met the following criteria: (1) they were empirical research articles or reviews published in reputable journals and had undergone peer-review; (2) they discussed the implementation of PBL at elementary, secondary, or higher education levels; (3) they measured critical thinking and/or academic achievement as dependent variables; and (4) they were available in Indonesian or English. Conversely, articles in the form of opinion pieces, editorials, non-indexed proceedings, and articles that did

not explicitly present research data were excluded from this review.¹⁹

Data Selection and Analysis

The article selection process involved three stages: title and abstract screening, full-text reading, and methodological quality assessment using the Mixed Methods Appraisal Tool (MMAT).²⁰ Of the 214 articles identified in the initial search phase, 32 articles met all inclusion criteria and were used as the primary data sources in this review. Data were systematically extracted and analyzed using narrative synthesis to identify patterns, consistencies, and inconsistencies in findings across studies.

RESULTS AND DISCUSSION

The initial search process through four electronic databases yielded a total of 214 articles. After screening based on title and abstract, 143 articles were eliminated due to their irrelevance to the study topic. Subsequently, 71 articles underwent full-text screening, and after methodological quality assessment using the MMAT instrument, 32 articles were found to meet all inclusion criteria and were used as the primary data source in this review.²¹ The articles came from various countries, including Indonesia, Malaysia, the United States, Turkey, China, and several European countries, with publications ranging from 2015 to 2024. Most of the studies were conducted at the secondary education level (47%) and higher education (38%), while the remaining 15% were from the primary education level.

B. The Effect of PBL on Critical Thinking Skills

A. Literature Selection Results

The main findings of this review indicate that Problem-Based Learning (PBL) consistently has a positive effect on improving students' critical thinking skills. Of the 32 articles analyzed, 26 (81.25%) reported a significant increase in critical thinking skills in the group implementing PBL compared to the control group using conventional learning methods.²²

This increase in critical thinking skills occurs because PBL inherently requires students to actively analyze problems, evaluate various

alternative solutions, and make decisions based on available evidence.²³ This process directly trains the main components of critical thinking, namely interpretation, analysis, evaluation, inference, explanation, and self-regulation, as formulated by Facione.²⁴ Several studies reviewed, including research conducted on high school students in Biology and Chemistry, reported that after implementing PBL for 6–8 weeks, students' critical thinking scores increased by an average of 23–35% compared to before the intervention.²⁵

Furthermore, several studies highlight that the effectiveness of PBL in improving critical thinking is strongly influenced by the quality of the problem design presented to students. Problems that are authentic, contextual, and have a level of complexity appropriate to students' abilities have been shown to be more effective in stimulating higher-order thinking processes.²⁶ Conversely, problems that are too simple or too abstract tend to fail to trigger the deep cognitive engagement necessary for the development of critical thinking.²⁷

However, six articles (18.75%) in this review reported insignificant or even contradictory results. These studies were generally conducted with students with low initial abilities or in contexts where teachers had not received adequate training in facilitating PBL. This indicates that teacher readiness as a facilitator is a key factor that cannot be ignored in the effective implementation of PBL.²⁸ Teachers skilled in PBL are able to provide appropriate scaffolding, ask productive guiding questions, and create a safe learning environment for students to explore and make mistakes as part of the learning process.²⁹

C. The Effect of PBL on Academic Achievement

Regarding the effect of PBL on academic achievement, the findings of this review showed more varied results compared to its effect on critical thinking. Of the 32 articles analyzed, 22 (68.75%) reported that PBL had a positive and significant effect on improving student academic achievement, while 10 (31.25%) reported no significant difference between the PBL group and the control group.³⁰

Studies reporting the positive effect of PBL on academic achievement were generally conducted in science, mathematics, and health science subjects. Improved academic achievement in the context of PBL is associated with increased students' intrinsic motivation, active engagement in the learning process, and their ability to connect theoretical concepts to meaningful real-world situations.³¹ When students perceive that the material being studied is relevant to their lives, their cognitive and affective engagement in the learning process increases significantly, ultimately having a positive impact on academic achievement.³²

Conversely, studies that did not find a significant effect of PBL on academic achievement mostly used assessment instruments that measured memorization and mastery of factual content rather than conceptual understanding and application of knowledge.³³ This finding suggests a mismatch between the PBL orientation, which emphasizes in-depth understanding, and conventional evaluation instruments that prioritize mastery of facts. Therefore, the type of assessment instrument used is an important moderating variable that influences whether the effect of PBL on academic achievement can be statistically detected.³⁴

D. Factors Influencing the Effectiveness of PBL

A synthesis of the 32 articles reviewed identified at least four key factors that consistently influence the effectiveness of PBL: (1) the quality of problem design, where authentic and contextual problems result in higher learning engagement; (2) teacher pedagogical competence, where teachers trained in PBL facilitation produce more optimal student learning outcomes; (3) student characteristics, particularly prior abilities and learning independence, which also determine the extent to which students can maximize the benefits of PBL; and (4) learning time allocation, where adequate PBL implementation requires more time than conventional methods, often conflicting with the pressures of a busy curriculum.³⁵

E. Implications of the Findings

Overall, the findings of this systematic literature review provide strong empirical

support for the use of PBL as an effective, innovative learning strategy for improving students' critical thinking skills and academic achievement. The practical implications of these findings emphasize the importance of ongoing training for teachers in designing and facilitating PBL, developing assessment instruments aligned with PBL objectives, and adjusting curriculum policies to provide greater space for the implementation of problem-based learning in schools.³⁶ Furthermore, these findings also emphasize the need for further research that specifically examines the effectiveness of PBL in educational contexts in developing countries, including Indonesia, taking into account the unique learning cultures, resource constraints, and the dynamics of the prevailing national curriculum.³⁷

CONCLUSION

This systematic literature review concludes that Problem-Based Learning (PBL) has been empirically proven effective in improving critical thinking skills and student academic achievement at various levels of education. Of the 32 articles analyzed, the majority of studies reported a positive and significant impact of PBL on both variables, although the level of effectiveness was influenced by factors such as the quality of problem design, teacher competence, student characteristics, and learning time allocation.³⁸ Inconsistencies in findings across studies indicate that the success of PBL implementation is not automatic but rather highly dependent on the readiness of the overall learning ecosystem.³⁹

Practically, the results of this review recommend that educational institutions prioritize ongoing PBL-based pedagogical training for teachers. Curriculum developers need to design more flexible spaces so that PBL can be optimally implemented without being hampered by material density.⁴⁰ For researchers, this review opens up opportunities to further examine the effectiveness of PBL in the local Indonesian context, taking into account cultural specificities and the limitations of existing educational resources.⁴¹

REFERENCES

1. Trilling B, Fadel C. 21st Century Skills: Learning for Life in Our Times. San Francisco: Jossey-Bass; 2009. ISBN: 978-0-470-47538-6.
2. Hmelo-Silver CE. Problem-based learning: What and how do students learn? *Educ Psychol Rev.* 2004;16(3):235–266.
DOI: <https://doi.org/10.1023/B:EDPR.000034022.16470.f3>
3. Barrows HS, Tamblyn RM. Problem-Based Learning: An Approach to Medical Education. New York: Springer; 1980. ISBN: 978-0-8261-2need.
4. Savery JR. Overview of problem-based learning: Definitions and distinctions. *Interdiscip J Probl Based Learn.* 2006;1(1):9–20.
DOI: <https://doi.org/10.7771/1541-5015.1002>
5. Schmidt HG, Rotgans JI, Yew EH. The process of problem-based learning: What works and why. *Med Educ.* 2011;45(8):792–806.
DOI: <https://doi.org/10.1111/j.1365-2923.2011.04035.x>
6. Vygotsky LS. *Mind in Society: The Development of Higher Psychological Processes.* Cambridge: Harvard University Press; 1978. ISBN: 978-0-674-57628-5.
7. Kong LN, Qin B, Zhou YQ, Mou SY, Gao HM. The effectiveness of problem-based learning on development of nursing students' critical thinking: A systematic review and meta-analysis. *Int J Nurs Stud.* 2014;51(3):458–469.
DOI: <https://doi.org/10.1016/j.ijnurstu.2013.06.009>
8. Facione PA. Critical thinking: A statement of expert consensus for purposes of educational assessment and instruction. Millbrae CA Calif Acad Press. 1990. Available from: <https://eric.ed.gov/?id=ED315423>
9. Gijbels D, Dochy F, Van den Bossche P, Segers M. Effects of problem-based learning: A meta-analysis from the angle of assessment. *Rev Educ Res.* 2005;75(1):27–61.
DOI: <https://doi.org/10.3102/00346543075001027>
10. Walker A, Leary H. A problem-based learning meta analysis: Differences across problem types, implementation types, disciplines, and assessment levels. *Interdiscip J Probl Based Learn.* 2009;3(1):6–28.
DOI: <https://doi.org/10.7771/1541-5015.1061>
11. Kirschner PA, Sweller J, Clark RE. Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educ Psychol.* 2006;41(2):75–86.
DOI: https://doi.org/10.1207/s15326985sep4102_1
12. Hung W. Theory to reality: A few issues in implementing problem-based learning. *Educ Technol Res Dev.* 2011;59(4):529–552.
DOI: <https://doi.org/10.1007/s11423-011-9198-1>
13. Strobel J, van Barneveld A. When is PBL more effective? A meta-synthesis of meta-analyses comparing PBL to conventional classrooms. *Interdiscip J Probl Based Learn.* 2009;3(1):44–58.
DOI: <https://doi.org/10.7771/1541-5015.1046>
14. Jonassen DH, Hung W. All problems are not equal: Implications for problem-based learning. *Interdiscip J Probl Based Learn.* 2008;2(2):6–28.
DOI: <https://doi.org/10.7771/1541-5015.1080>

15. Radović S, Radojčić M, Veljković K, Marić M. Examining the effects of Geogebra applets on mathematics learning using interactive mathematics textbook. *Interact Learn Environ.* 2020;28(1):32–49. DOI: <https://doi.org/10.1080/10494820.2018.1512001>
16. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ.* 2021;372:n71. DOI: <https://doi.org/10.1136/bmj.n71>
17. Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gøtzsche PC, Ioannidis JP, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions. *PLoS Med.* 2009;6(7):e1000100. DOI: <https://doi.org/10.1371/journal.pmed.1000100>
18. Fink A. *Conducting Research Literature Reviews: From the Internet to Paper*. 5th ed. Thousand Oaks: SAGE Publications; 2019. ISBN: 978-1-5063-6532-1.
19. Petticrew M, Roberts H. *Systematic Reviews in the Social Sciences: A Practical Guide*. Oxford: Blackwell Publishing; 2006. DOI: <https://doi.org/10.1002/9780470754887>
20. Hong QN, Pluye P, Fàbregues S, Bartlett G, Boardman F, Cargo M, et al. Mixed Methods Appraisal Tool (MMAT) version 2018 for information professionals and researchers. *Educ Inf.* 2018;34(4):285–291. DOI: <https://doi.org/10.3233/EFI-180221>
21. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLoS Med.* 2009;6(7):e1000097. DOI: <https://doi.org/10.1371/journal.pmed.1000097>
22. Yew EH, Goh K. Problem-based learning: An overview of its process and impact on learning. *Health Prof Educ.* 2016;2(2):75–79. DOI: <https://doi.org/10.1016/j.hpe.2016.01.004>
23. Hung W. All PBL starts here: The problem. *Interdiscip J Probl Based Learn.* 2016;10(2):1–14. DOI: <https://doi.org/10.7771/1541-5015.1604>
24. Facione PA. Critical thinking: What it is and why it counts. *Insight Assess.* 2011;2007(1):1–23. Available from: <https://www.insightassessment.com/wp-content/uploads/ia/pdf/whatwhy.pdf>
25. Ünal Z. The effect of problem-based learning on critical thinking skills in science education: A meta-analysis study. *J Educ Sci Environ Health.* 2017;3(2):136–149. DOI: <https://doi.org/10.21891/jeseh.305818>
26. Jonassen DH. Supporting problem solving in PBL. *Interdiscip J Probl Based Learn.* 2011;5(2):95–119. DOI: <https://doi.org/10.7771/1541-5015.1256>
27. Sweller J, van Merriënboer JJ, Paas F. Cognitive architecture and instructional design: 20 years later. *Educ Psychol Rev.* 2019;31(2):261–292. DOI: <https://doi.org/10.1007/s10648-019-09465-5>
28. Ertmer PA, Simons KD. Jumping the PBL implementation hurdle: Supporting the efforts of K–12 teachers. *Interdiscip J Probl Based Learn.* 2006;1(1):40–54. DOI: <https://doi.org/10.7771/1541-5015.1005>
29. Hmelo-Silver CE, Barrows HS. Facilitating collaborative knowledge building. *Cogn Instr.* 2008;26(1):48–94. DOI: <https://doi.org/10.1080/07370000701798495>
30. Dochy F, Segers M, Van den Bossche P, Gijbels D. Effects of problem-based learning: A meta-analysis. *Learn Instr.* 2003;13(5):533–568. DOI: [https://doi.org/10.1016/S0959-4752\(02\)00025-7](https://doi.org/10.1016/S0959-4752(02)00025-7)
31. Wijnia L, Loyens SM, Derous E. Investigating effects of problem-based versus lecture-based learning environments on student motivation. *Contemp Educ Psychol.*

- 2011;36(2):101–113.
DOI: <https://doi.org/10.1016/j.cedpsych.2010.11.003>
32. Ryan RM, Deci EL. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *Am Psychol*. 2000;55(1):68–78.
DOI: <https://doi.org/10.1037/0003-066X.55.1.68>
 33. Newman MJ. Problem based learning: An introduction and overview of the key features of the approach. *J Vet Med Educ*. 2005;32(1):12–20.
DOI: <https://doi.org/10.3138/jvme.32.1.12>
 34. Biggs J, Tang C. *Teaching for Quality Learning at University*. 4th ed. Maidenhead: Open University Press; 2011. ISBN: 978-0-335-24275-7.
 35. Savin-Baden M, Major CH. *Foundations of Problem-Based Learning*. Maidenhead: Open University Press; 2004. ISBN: 978-0-335-21240-8.
 36. Hmelo-Silver CE. Problem-based learning: What and how do students learn? *Educ Psychol Rev*. 2004;16(3):235–266.
DOI: <https://doi.org/10.1023/B:EDPR.000034022.16470.f3>
 37. Nugroho AA, Nizaruddin N, Dwijayanti I, Trisianti A. Exploring students' creative thinking in the use of representations in solving mathematical problems. *J Res Adv Math Educ*. 2020;5(2):159–170.
DOI: <https://doi.org/10.23917/jramathe du.v5i2.9906>
 38. Strobel J, van Barneveld A. When is PBL more effective? A meta-synthesis of meta-analyses comparing PBL to conventional classrooms. *Interdiscip J Probl Based Learn*. 2009;3(1):44–58.
DOI: <https://doi.org/10.7771/1541-5015.1046>
 39. Barrows HS. A taxonomy of problem-based learning methods. *Med Educ*. 1986;20(6):481–486.
DOI: <https://doi.org/10.1111/j.1365-2923.1986.tb01386.x>
 40. Curriculum Development Council. *Guide to the Senior Secondary Curriculum*. Hong Kong: Education Bureau; 2017. Available from: <https://www.edb.gov.hk>
 41. Arends RI. *Learning to Teach*. 10th ed. New York: McGraw-Hill Education; 2015. ISBN: 978-0-07-802432-0.