JPPIPA 11(12) (2025)

Jurnal Penelitian Pendidikan IPA

http://jppipa.unram.ac.id/index.php/jppipa/index

Problem-Based Learning (PBL), Problem-Solving Skills, and Self-Efficacy: A Systematic Literature Review

I Made Sudarman Utama[1*], I Wayan Redhana[1], I Nyoman Tika[1], Ida Bagus Putu Arnyana[1], Ni Ketut Rapi[1]

[1] Master's Program in Science Education, Postgraduate School, Ganesha University of Education, Singaraja, Indonesia.

Received: September 10, 2025
Revised: November 14, 2025
Accepted: December 25, 2025
Published: December 31, 2025

Corresponding Author:
I Made Sudarman Utama
sudarmanutama@gmail.com

DOI: 10.29303/jppipa.v11i12.12817

Abstract: Problem-solving skills and self-efficacy are essential competencies that enable students to face academic and real-life challenges, particularly in science learning. One instructional approach frequently associated with the development of these competencies is the Problem-Based Learning (PBL) model. However, research findings on the effectiveness of PBL in enhancing problem-solving skills and self-efficacy show varied results and have not been systematically synthesized, especially in the context of science education. Therefore, this study aims to identify and describe trends in research subjects, research designs, and types, as well as key findings related to the application of the PBL model to problem-solving skills and self-efficacy through a Systematic Literature Review (SLR). This study analyzed 20 research articles published over the last ten years (2016–2025) and indexed in the Directory of Open Access Journals (DOAJ). The selected articles were examined using a content analysis observation sheet to identify research subjects, methodological approaches, and key findings. The results show that research on PBL is dominated by studies conducted at the senior high school level, while research at the elementary and junior high school levels remains limited. Quantitative research designs, particularly quasi-experimental studies, predominate, with relatively few qualitative, mixed-methods, and research and development (R&D) studies. The key findings reveal variations in the achievement of problem-solving skill indicators and self-efficacy dimensions across studies. These findings indicate that although the PBL model has the potential to enhance problem-solving skills and self-efficacy, its effectiveness is influenced by student characteristics, learning contexts, and instructional design. This study highlights the need for further research, particularly at the elementary and junior high school levels, and encourages methodological diversification as well as the integration of PBL with other learning models and instructional strategies. Overall, this SLR provides a comprehensive overview that can serve as a reference for researchers and educators in developing more effective and context-sensitive PBL implementations in science education.

Keywords: Problem-based learning; Problem-solving skills; Self-efficacy

Introduction

Education is required to prepare students to face future challenges and to develop confidence in their own potential. Students are expected to be able to extrapolate what they have learned and apply their knowledge in new and unfamiliar situations (OECD, 2023). This readiness can be fostered through the development of problem-solving skills and self-efficacy, which are considered essential competencies in modern education. Problem-solving skills are crucial because students will inevitably encounter various problems that require creative and systematic solutions (Sumiantari et al., 2019). In addition, fostering students' self-efficacy is necessary to strengthen their confidence in the learning process. Higher levels of self-efficacy are associated with

How to Cite:
Utama, I. M. S., Redhana, I. W., Tika, I. N., Arnyana, I. B. P., & Rapi, N. K. (2025). Problem-Based Learning (PBL), Problem-Solving Skills, and Self-Efficacy: A Systematic Literature Review. *Jurnal Penelitian Pendidikan IPA*, *11*(12), 130-139. https://doi.org/10.29303/jppipa.v11i12.12817

greater effort and perseverance when students face learning challenges and problem-solving tasks (Amanda et al., 2014). Therefore, learning processes, including science education, should habituate students to make decisions confidently by integrating strong problem-solving skills and self-efficacy.

Problem-solving skills refer to the ability of individuals or groups to resolve problems through a series of structured stages. These stages include understanding the problem, planning a solution, implementing the solution, and reviewing the results (Polya, 1973). In science learning, problem-solving skills support students in developing a deeper understanding of scientific concepts. Learning activities that emphasize problem-solving train students to think systematically and carefully (Hadi & Radiyatul, 2014). Furthermore, problem-solving skills encourage students to construct knowledge, apply scientific concepts, and relate learning experiences to real-life contexts (Sumiantari et al., 2019).

Despite their importance, current conditions indicate that many students still experience difficulties in solving science-related problems. Several contributing factors have been identified. Teachers often prioritize concept mastery and the achievement of minimum assessment standards (Zebua et al., 2025). As a result, students tend to rely on memorization and demonstrate limited ability to apply concepts in problem-solving contexts (Mariana et al., 2022). This situation ultimately affects students' decision-making abilities, which are not yet optimally developed.

In addition to problem-solving skills, self-efficacy plays a significant role in influencing individuals' actions and decisions. Self-efficacy is defined as an individual's belief in their capability to organize and execute the actions required to achieve specific goals (Bandura & Adams, 1997). Higher self-efficacy is associated with stronger problem-solving abilities (Fauziana, 2022). Self-efficacy influences behavioral choices, the level of effort exerted, persistence, and students' motivation to learn (Yulita & Defrinal, 2024).

However, students' self-efficacy in science learning is also reported to be relatively low. This condition is reflected in behaviors such as cheating during assessments and a lack of confidence in presenting ideas or expressing opinions during classroom activities. Students with low self-confidence in science learning tend to be less active in discussions and more inclined to engage in dishonest practices (Rahayu et al., 2018). Consequently, this situation limits students' ability to make strategic and independent decisions.

From an operational perspective, educational practices should be consciously and systematically designed to develop both problem-solving skills and self-efficacy. One practical approach to achieving this goal is the implementation of learning models that are aligned with these competencies. Problem-Based Learning (PBL) is recognized as an innovative learning model that is relevant to developing problem-solving skills and self-efficacy.

The PBL model emphasizes the use of contextual problems as the foundation for understanding scientific concepts. The problems presented are closely related to students' everyday experiences, encouraging meaningful learning. PBL provides opportunities for students to identify relevant problems and actively engage in problem-solving activities (Sepriyani et al., 2018). Previous studies have reported that PBL has a positive impact on the learning process and can enhance students' problem-solving skills (Yasin & Novaliyosi, 2023). In addition, the implementation of PBL has been shown to increase student motivation and improve the effectiveness of science learning (Dinda R & Atmojo, 2024). Through these processes, PBL allows students to participate actively in learning while strengthening both problem-solving skills and self-efficacy.

Numerous studies have demonstrated the effectiveness of the PBL model in improving students' problem-solving abilities. PBL has been shown to motivate students to engage more actively in problem-solving tasks ('Adiilah & Haryanti, 2023) and is considered one of the most relevant and effective approaches for developing problem-solving skills (Handayani et al., 2024). The model facilitates deep analysis and the synthesis of information required to solve complex problems. Moreover, PBL has also been found to influence students' self-efficacy (Sujarwo, 2020).

Although many studies have examined the relationship between PBL and problem-solving skills, particularly in mathematics, research that simultaneously investigates PBL, problem-solving skills, and self-efficacy in science education remains limited. In particular, systematic literature reviews addressing these three variables in the context of science learning are still scarce. This gap is significant, considering that problem-solving skills and self-efficacy are generic competencies that should be developed across all subject areas, including science.

Therefore, this study aims to identify and describe trends in research subjects, research designs, and key findings related to the application of PBL to problem-solving skills and self-efficacy in science education. Through this systematic review, a comprehensive understanding of the contribution of the PBL model to these two competencies can be obtained. The findings of this review are expected to assist researchers and educational practitioners in mapping areas that have been sufficiently explored and those that remain under-researched, thereby supporting the development of relevant and practical strategies to enhance problem-solving skills and self-efficacy in science learning.

Method

This study employed the Systematic Literature Review (SLR) method to synthesize empirical evidence related to the application of the Problem-Based Learning (PBL) model to problem-solving skills and self-efficacy in science education. The SLR method was selected because it enables researchers to systematically collect and integrate findings from previous studies in order to answer predefined research questions in a transparent and replicable manner (Pollock & Berge, 2018). In line with this purpose, the SLR is commonly used to identify, evaluate, collect, and analyze relevant studies to provide a comprehensive understanding of a particular research topic (Snyder, 2019).

This review was conducted to identify and describe trends in research subjects, research designs, and research types, as well as the key findings of studies examining the implementation of the PBL model in relation to problem-solving skills and self-efficacy. Accordingly, the focus of the review was directed toward understanding how PBL has been investigated across different educational levels, how methodological approaches have been applied, and what outcomes have been reported in science education contexts.

The process of identifying relevant articles began with determining the data source, publication period, and search keywords. Articles were retrieved from the Directory of Open Access Journals (DOAJ), which is accessible at https://doaj.org/. DOAJ is a globally recognized index of peer-reviewed open-access journals and is widely regarded as a gold standard for open-access scholarly publishing. Therefore, it was considered a reliable and representative source for identifying articles relevant to the research objectives. The literature search was conducted in April 2025, covering a publication period of ten years, starting from 2016. This time frame was chosen to capture recent developments and research trends related to the PBL model over the past decade.

The search process employed keywords such as PBL, problem-solving skills, problem-solving, and self-efficacy to ensure the retrieval of studies aligned with the research focus. Following the search, the articles were screened based on predefined inclusion criteria. Only full-text original research articles written in Indonesian or English were included. In addition, the selected studies had to focus on science or science education and explicitly address the application of the PBL model in relation to problem-solving skills, self-efficacy, or both variables. Through this selection process, a total of 20 articles were identified as meeting the inclusion criteria and were subsequently analyzed. The overall process of article identification, screening, and selection followed the PRISMA framework, as illustrated in Figure 1.

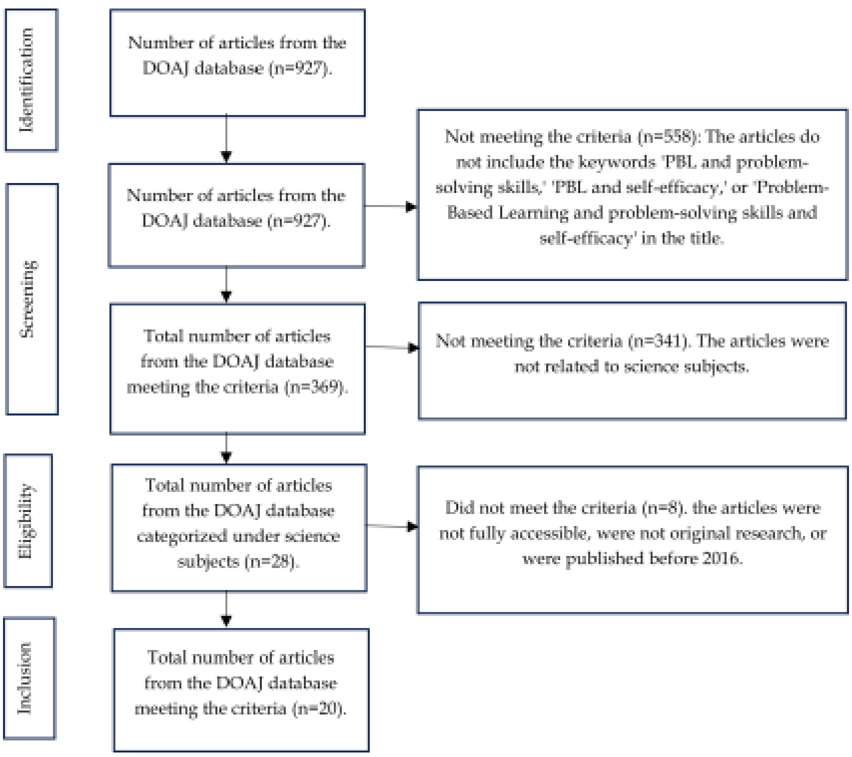

Figure 1. PRISMA model

Data analysis was conducted using a content analysis observation sheet adapted from Susetyarini & Fauzi (2020). This instrument was used to systematically extract and categorize information from each selected article, including research subjects, research designs and research types, and key findings. The inclusion of key findings as a core analytical component was essential to address the research objectives and to provide a comprehensive synthesis of evidence regarding the effectiveness and challenges of implementing the PBL model in enhancing problem-solving skills and self-efficacy in science education.

Result and Discussion

The results of this systematic literature review are presented according to the research questions, namely trends in research subjects, research designs and types, and key findings related to the application of the Problem-Based Learning (PBL) model to problem-solving skills and self-efficacy in science education.

The application of the PBL model in science education has been implemented across elementary, secondary, and higher education levels, as shown in Figure 2. The findings indicate that senior high school students dominate the research subjects in studies applying the PBL model. This is followed by junior high school students, while research conducted at the elementary school and university levels remains limited. Specifically, of the 20 articles analyzed over the past ten years, only four studies focused on junior high school students, and these studies primarily examined the effect of PBL on problem-solving skills.

These findings suggest that research examining the influence of the PBL model on self-efficacy, as well as studies integrating self-efficacy with problem-solving skills, still has considerable potential to be expanded, particularly at the junior high school level. Problem-solving is widely regarded as a core 21st-century competence because people constantly face novel, complex challenges at school, work, and in daily life, and addressing these often requires creative, non-routine thinking (Simanjuntak et al., 2021; Wang et al., 2023; Khamcharoen et al., 2022; Nicholus et al., 2023). Problem-solving skills are essential because individuals continuously encounter problems that require creative solutions (Zebua et al., 2025). Furthermore, students with high self-efficacy tend to demonstrate perseverance when facing complex problems (Sunaryo, 2017). Therefore, strengthening problem-solving skills and self-efficacy from the elementary and junior high school levels is critical. In this context, the PBL model serves as an innovative learning approach capable of supporting the development of these competencies.

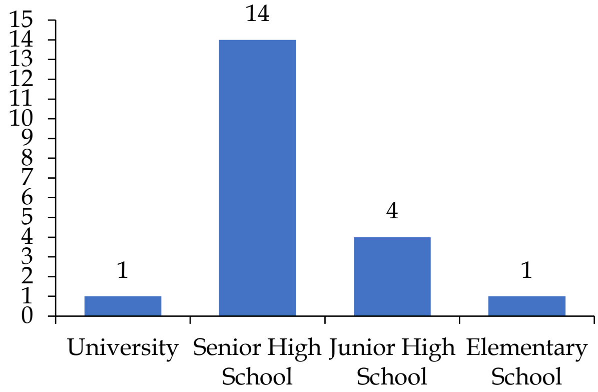

Figure 2. Research subjects

The analysis of the reviewed articles shows that quantitative research dominates studies on the application of the PBL model in science education, as illustrated in Figure 3. Most of these quantitative studies employ experimental approaches, particularly quasi-experimental designs. In contrast, research and development (R&D), qualitative, and mixed-methods studies are relatively limited.

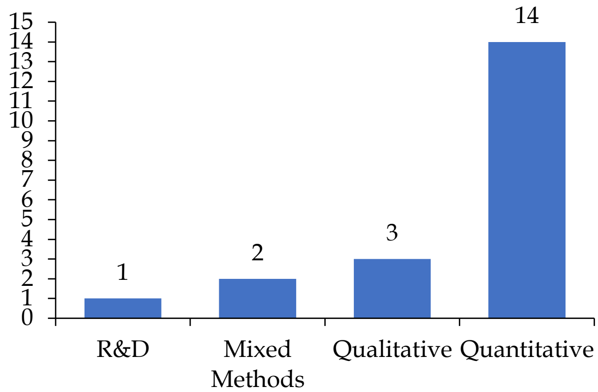

Figure 3. Research design

Quantitative research in education is commonly conducted to obtain empirical data that can be used to test, verify, and refine educational theories (Rukminingsih et al., 2020). Experimental designs are especially relevant for examining cause-and-effect relationships between variables (Gall et al., 2003). Among these, quasi-experimental designs are the most frequently used, as they allow researchers to investigate instructional interventions using intact classroom groups. This preference is largely influenced by practical constraints in educational settings, such as administrative policies that limit random assignment of participants (Rasyid, 2022). Consequently, researchers often designate existing classes as experimental and control groups, making quasi-experimental designs more feasible while still maintaining acceptable methodological rigor (Cook & Campbell, 1979).

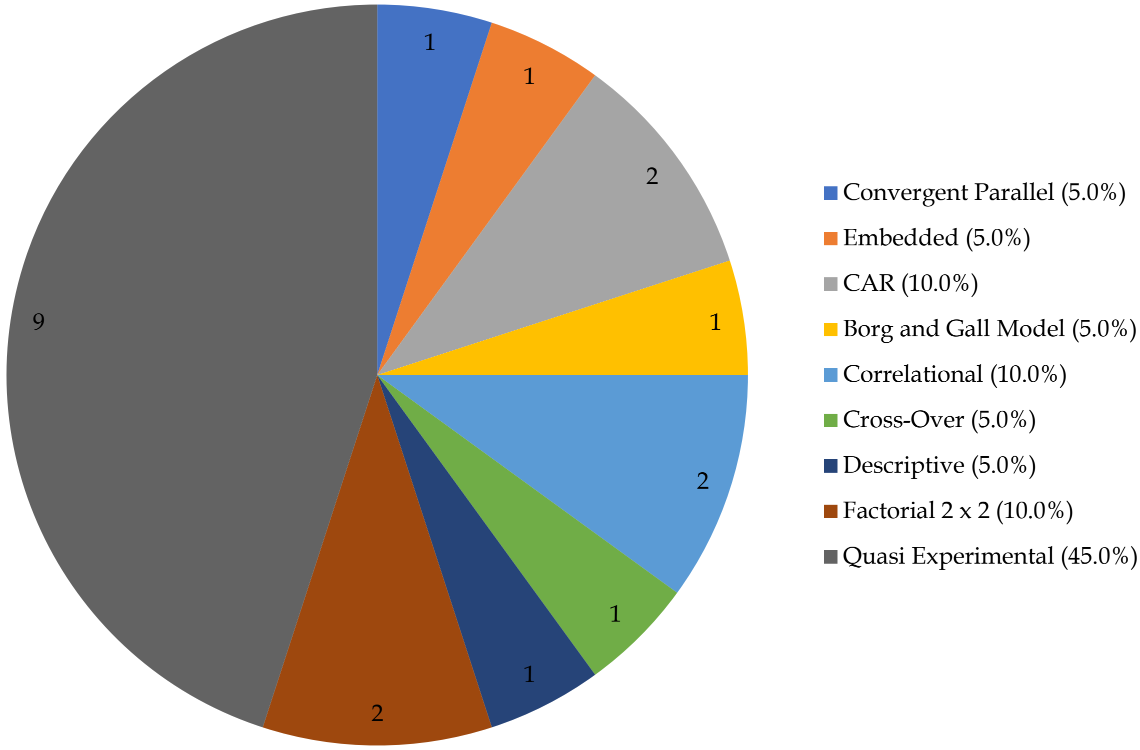

Figure 4. Design types of research

Despite the dominance of quantitative and quasi-experimental approaches, the limited use of qualitative, mixed-methods, and R&D designs indicates a gap in research diversity. These approaches have the potential to provide deeper insights into learning processes, contextual factors, and the development of instructional products that support the implementation of PBL. Quantitative studies are often strong in inferential power but tend to inadequately capture the dynamics of the learning process, subjective experiences, and contextual factors that influence the success of PBL (Zen et al., 2022; Zhong et al., 2025). Therefore, future research is encouraged to adopt more varied research designs and types to comprehensively examine how PBL influences problem-solving skills and self-efficacy in science education.

The key findings of the analysis of the PBL model's effect on problem-solving skills and self-efficacy are presented in Table 1. Upon further exploration, varied results were found in the application of PBL to problem-solving abilities. This indicates that there is inconsistency in applying PBL to problem-solving skills. For example, research by Sarkity et al. (2018) found that the PBL model could improve problem-solving skills in solving physics moment problems. In contrast, Kinasih et al. (2023) reported that students' ability to solve physics problems was relatively low, with only one indicator, problem analysis, categorized as good, while planning, creating, and evaluating solutions were considered low. Further detailed analysis by Saputri & Febriani (2017) found that problem-solving abilities were highest in diagnosing problems and lowest in evaluating solution strategies. According to Ekasari et al. (2018), there was a positive change in defining the problem stage, but the ability to understand causal relationships in problems remained low. Furthermore, Komala et al. (2021) showed that the PBL model affected students' problem-solving skills in biodiversity content, though some students still struggled to find the right solution.

Another important finding is the influence of the PBL model on students' self-efficacy. After specifically reviewing articles published within the last ten years, it was found that the number of studies examining PBL in relation to self-efficacy remains very limited. Considering the crucial role of self-efficacy for students, this situation presents a valuable opportunity for further research focusing on its improvement. According to Fitriani et al. (2020), the PBLPOE model is the most effective in promoting students' problem-solving skills and self-efficacy. Therefore, the PBLPOE model is recommended for implementation across a more diverse population and educational levels. Furthermore, Larasati et al. (2019) reported that there is an interaction between the PBL model and self-efficacy levels in influencing problem-solving skills, which include problem formulation, hypothesis development, data collection, drawing conclusions, and decision-making.

Interestingly, the study by Emrisena et al. (2018) presents a contradictory finding, revealing that there was no interaction between the PBL model and self-efficacy in relation to science process skills, specifically in problem formulation and hypothesis development. Based on these findings, there is significant research potential in developing various PBL innovations to help students adapt more effectively to the implementation of this learning model. Further analysis by Wahyuni & Miterianifa (2019) revealed that PBL-based student worksheets improved self-efficacy among students with low self-efficacy, particularly in the dimensions of generality and magnitude. This finding is supported by Diani et al. (2019), who found that PBL-based scaffolding was effective in enhancing students' conceptual understanding and self-efficacy in physics learning; however, the increase in self-efficacy was relatively low. In particular, the experimental group scored lower in the generality dimension. These findings highlight opportunities for further studies, especially by integrating PBL with other learning models to maximize its impact on student's self-efficacy. This research direction is not only interesting but also essential, as high self-efficacy fosters independence and resilience, shaping students into strong and self-reliant individuals.

The results of this SLR comparing key findings reveal that there are still challenges in empowering and improving students' problem-solving skills and self-efficacy. For example, the integration of the PBL model used may improve problem-solving skills and self-efficacy, or just one of these variables, which may not necessarily be the case in other schools. This means that the innovation of the PBL model needs to consider the characteristics of students and the topic being studied. The implementation of the PBL model requires an extended period for further information gathering (Ghufron & Ermawati, 2018). Students' low reading interest has become an obstacle to gaining an initial understanding of the topic as a step toward problem-solving (Ghani et al., 2021). Based on this, PBL has not been able to provide in-depth material at the beginning as the next step for problem-solving. This situation provides an opportunity for researchers to combine the PBL model with other models as an effective mitigation strategy to empower problem-solving skills and self-efficacy. This research also has a limited scope, focusing only on one data source and on the variables of problem-solving skills and self-efficacy in science education. Additionally, this study contributes to the research trend of systematic reviews on problem-solving skills in science education. So far, systematic reviews on problem-solving skills and self-efficacy in science education are very limited. Therefore, there is an opportunity to conduct further SLR research to complete and expand the findings of this study.

Table 1. Important research result

Authors (Year)	Important Results
Aprilia et al. (2020)	PBL significantly improved problem-solving skills on temperature and energy topics; students responded positively.
Knopfel et al. (2024)	PBL enhanced short-term problem-solving skills and knowledge acquisition.
Emrisena et al. (2018)	PBL affected science process skills, but no interaction with self-efficacy was found.
Zebua et al. (2025)	PBL-based science modules significantly improved students' problem-solving skills.
Komala et al. (2021)	PBL improved problem-solving skills in biodiversity content, although some students struggled to find correct solutions.
Kinasih et al. (2023)	Problem-solving skills remained low in several indicators, highlighting the need for habituation through PBL.
Khoiriyah & Husamah (2018)	PBL improved creative thinking, problem-solving skills, and learning outcomes.
Sari et al. (2024)	CS-PBL showed a positive relationship between science literacy and problem-solving skills.
Leasa et al. (2021)	PBL correlated with creative thinking and problem-solving skills in elementary education.
Wahyuni & Miterianifa (2019)	PBL-based worksheets slightly improved students' self-efficacy.
Fitriani et al. (2020)	PBLPOE was effective in improving both problem-solving skills and self-efficacy.
Oktavia et al. (2024)	PBL improved learning outcomes and problem-solving abilities.
Mustajab et al. (2020)	7-step PBL improved problem-solving skills regardless of scientific reasoning levels.
Larasati et al. (2019)	PBL increased problem-solving skills, with differences based on self-efficacy levels.
Pitaloka & Suyanto (2019)	Blended-PBL effectively improved problem-solving skills in ecology.
Pucangan et al. (2018)	Conceptual scaffolding in PBL improved problem-solving skills.
Ekasari et al. (2018)	PBL improved problem definition but not causal reasoning.
Sarkity et al. (2018)	PBL improved students' ability to solve physics moment problems.
Diani et al. (2019)	PBL-based scaffolding improved self-efficacy, though gains were limited.
Saputri & Febriani (2017)	PBL enhanced readiness to solve problems; evaluation indicators remained weakest.

Conclusion

This systematic literature review indicates that, over the past ten years, research on the application of the Problem-Based Learning (PBL) model to problem-solving skills and self-efficacy in science education has been limited to 20 articles indexed in the DOAJ database, with fluctuating publication trends between 2017 and 2025. The reviewed studies predominantly focus on senior high school students, while research at the elementary and junior high school levels remains scarce, despite the importance of developing these competencies from an early educational stage. Methodologically, quantitative research designs—particularly quasi-experimental studies—dominate the existing literature. The limited use of qualitative, mixed-methods, and R&D approaches suggests a need for greater methodological diversity to better understand learning processes and to develop innovative instructional models. The analysis of key findings reveals variations in the achievement of problem-solving skill indicators and self-efficacy dimensions, indicating that the effectiveness of PBL is context-dependent and influenced by student characteristics and instructional design. Overall, this SLR highlights the need for systematic efforts to improve students' problem-solving skills and self-efficacy, particularly at the elementary and junior high school levels. Future research is encouraged to explore innovative adaptations of the PBL model, including its integration with other learning models, media, and instructional approaches, to optimize its impact. Further systematic literature reviews using broader data sources are also recommended to address the limitations of this study and to strengthen the evidence base for PBL implementation in science education.

Acknowledgments
The author would like to thank all those who have helped in this research.

Author Contributions
Author 1 was responsible for conceptualizing the study, formulating the research objectives and research questions, and designing the systematic literature review protocol. Author 1 also conducted the literature search, article screening, and selection process, performed data analysis, interpreted the findings, and prepared the initial draft of the manuscript. Author 2 contributed to refining the research methodology, validating the inclusion and exclusion criteria, and reviewing the data extraction and analysis process to ensure consistency and accuracy. Author 3 also provided substantive input on the results and discussion sections and participated in revising the manuscript. Author 4 and 5 contributed to the synthesis and interpretation of the findings, reviewed the coherence between the abstract, methods, results, and conclusion, and provided critical revisions to improve the clarity, structure, and academic quality of the manuscript. All authors reviewed and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

Funding
This research received no external funding.

Conflicts of Interest
The authors declare no conflict of interest.

References

'Adiilah, I. I., & Haryanti, Y. D. (2023). Pengaruh Model Problem Based Learning Terhadap Kemampuan Berpikir Kreatif Siswa pada Pembelajaran IPA. *Papanda Journal of Mathematics and Science Research*, *2*(1), 49–56. https://doi.org/10.56916/pjmsr.v2i1.306

Amanda, N. W. Y., Subagia, I. W., & Tika, I N. (2014). Pengaruh Model Pembelajaran Berbasis Proyek Terhadap Hasil Belajar IPA Ditinjau dari Self Efficacy Siswa. *E-Journal Program Pascasarjana Universitas Pendidikan Ganesha Program Studi IPA*, *4*(1), 1–11. Retrieved from https://ejournal-pasca.undiksha.ac.id/index.php/jurnal_ipa/article/view/1106

Aprilia, A. V., Parmin, P., & Wusqo, I. U. (2020). The Influence of Problem-Based Learning Model on Heat and Its Transfer Topic Toward Junior High School Students Problem-Solving Skills. *Unnes Science Education Journal*, *9*(2), 116–119. https://doi.org/10.15294/usej.v9i2.42906

Bandura, A., & Adams, N. E. (1997). Analysis of Self-Efficacy Theory of Bahavioral Change. *Cognitive Therapy and Research*, *1*(4), 287–310. https://doi.org/10.1007/BF01663995

Cook, T. D., & Campbell, D. T. (1979). *Quasi-Experimentation: Design and Analysis Issues for Field Settings*. Houghton Mifflin.

Diani, R., Khotimah, H., Khasanah, U., & Syarlisjiswan, M. R. (2019). Scaffolding dalam Pembelajaran Fisika Berbasis Problem Based Instruction (PBL): Efeknya Terhadap Pemahaman Konsep dan Self Efficacy. *Indonesian Journal of Science and Mathematics Education*, *2*(3), 310–319. https://doi.org/10.24042/ijsme.v2i3.4356

Dinda R, S., & Atmojo, S. (2024). Efektivitas Model Problem Based Learning (PBL) Terhadap Kemampuan Pemecahan Masalah dan Motivasi Siswa pada Pembelajaran IPA di Kelas V SD Negeri 1 Padokan. *LENSA (Lentera Sains): Jurnal Pendidikan IPA*, *14*(1), 48–57. https://doi.org/10.24929/lensa.v14i1.399

Ekasari, A., Diantoro, M., & Parno, P. (2018). Peningkatan Kemampuan Pemecahan Masalah Siswa SMAN 1 Gondang pada Materi Kalor dengan Pembelajaran Berbasis Masalah. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, *3*(1), 588–597. https://doi.org/10.17977/jptpp.v3i5.11001

Emrisena, A., Abdurrahman, A., & Suyanto, E. (2018). Pengaruh Model Pembelajaran Problem Based Learning Terhadap Keterampilan Proses Sains

Ditinjau dari Self-Efficacy Siswa. *Jurnal Pendidikan Fisika*, *6*(2), 196–208. http://dx.doi.org/10.24127/jpf.v6i2.1306

Fauziana, F. (2022). Pengaruh Self Efficacy Terhadap Kemampuan Memecahkan Masalah IPA. *Pionir: Jurnal Pendidikan*, *11*(1), 2022. https://doi.org/10.22373/pjp.v11i1.13138

Fitriani, A., Zubaidah, S., Susilo, H., & Al Muhdhar, M. H. I. (2020). The Effects of Integrated Problem-Based Learning, Predict, Observe, Explain on Problem-Solving Skills and Self-Efficacy. *Eurasian Journal of Educational Research*, *1*(85), 45–64. https://doi.org/10.14689/ejer.2020.85.3

Gall, M., Borg, W., & Gall, J. (2003). Educational Research: An Introduction. *British Journal of Educational Studies*, *32*. https://doi.org/10.2307/3121583

Ghani, A. S. A., Rahim, A. F. A., Yusoff, M. S. B., & Hadie, S. N. H. (2021). Effective Learning Behavior in Problem-Based Learning: A Scoping Review. *Medical Science Educator*, *31*(3), 1199–1211. https://doi.org/10.1007/s40670-021-01292-0

Ghufron, M. A., & Ermawati, S. (2018). The Strengths and Weaknesses of Cooperative Learning and Problem-Based Learning in EFL Writing Class: Teachers and Students' Perspectives. *International Journal of Instruction*, *11*(4), 657–672. https://doi.org/10.12973/iji.2018.11441a

Hadi, S., & Radiyatul, R. (2014). Metode Pemecahan Masalah Menurut Polya untuk Mengembangkan Kemampuan Siswa dalam Pemecahan Masalah Matematis di Sekolah Menengah Pertama. *EDU-MAT: Jurnal Pendidikan Matematika*, *2*(1), 53–61. https://doi.org/10.20527/edumat.v2i1.603

Handayani, A., Wati, M., Dewantara, D., & Setiono, I. A. (2024). Efektivitas Model Pembelajaran dalam Meningkatkan Kemampuan Pemecahan Masalah Fisika: Systematic Literature Review (SLR). *Seminar Nasional Pembelajaran Matematika, Sains dan Teknologi*, *4*, 87–95. Retrieved from http://e-jurnal.fkip.unila.ac.id/index.php/SINAPMASAGI/article/view/790/367

Khamcharoen, N., Kantathanawat, T., & Sukkamart, A. (2022). Developing Student Creative Problem-Solving Skills (CPSS) Using Online Digital Storytelling: A Training Course Development Method. *Int. J. Emerg. Technol. Learn.*, *17*(11), 17-34. https://doi.org/10.3991/ijet.v17i11.29931

Khoiriyah, A. J., & Husamah, H. (2018). Problem-Based Learning: Creative Thinking Skills, Problem-Solving Skills, and Learning Outcome of Seventh Grade Students. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, *4*(2), 151–160. https://doi.org/10.22219/jpbi.v4i2.5804

Kinasih, R. A., Prahani, B. K., Wibowo, F. C., & Costu, B. (2023). Profile of Students' Physics Problem Solving Skills and Implementation PBL Model Assisted by 3D Digital Module to Improve Problem Solving Skills. *Jurnal Penelitian & Pengembangan Pendidikan Fisika*, *9*(2), 245–256. https://doi.org/10.21009/1.09207

Knopfel, M., Kalz, M., & Meyer, P. (2024). General Problem-Solving Skills Can Be Enhanced by Short-Time Use of Problem Based Learning (PBL). *Journal of Problem Based Learning in Higher Education*, *12*(1), 72–91. https://doi.org/10.54337/ojs.jpblhe.v12i1.7871

Komala, R., Heryanti, E., & Rinawati, A. (2021). Effect of Problem-Based Learning Model on Biodiversity Problem-solving Skills. *Biosfer: Jurnal Pendidikan Biologi*, *14*(1), 120–131. https://doi.org/10.21009/biosferjpb.16325

Larasati, A. D. P., Ibnu, S., & Santoso, A. (2019). Model Problem Based Learning dengan Pendekatan Multi Representasi untuk Meningkatkan Kemampuan Memecahkan Masalah Siswa dengan Tingkat Self-Efficacy Berbeda. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, *4*(6), 828–834. https://doi.org/10.17977/jptpp.v4i6.12548

Leasa, M., Fenanlampir, A., Batlolona, J. R., & Saimima, A. S. (2021). Problem-Solving and Creative Thinking Skills with The PBL Model: The Concept of The Human Circulatory System. *Biosfer*, *14*(2), 154–166. https://doi.org/10.21009/biosferjpb.20825

Mariana, E., Wardany, K., & Asih, D. A. S. (2022). Pengaruh Model Problem Based Learning Terhadap Peningkatan Pemecahan Masalah Siswa pada Pembelajaran IPA. *Jurnal Pendidikan MIPA*, *12*(3), 395–401. https://doi.org/10.37630/jpm.v12i3.621

Mustajab, A., Muhardjito, M., & Sunaryono, S. (2020). Pengaruh 7-Step Problem Based Learning Terhadap Kemampuan Pemecahan Masalah Ditinjau dari Kemampuan Bernalar Ilmiah. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, *5*(3), 332–339. https://doi.org/10.17977/jptpp.v5i3.14086

Nicholus, G., Muwonge, C., & Joseph, N. (2023). The Role of Problem-Based Learning Approach in Teaching and Learning Physics: A Systematic Literature Review. *F1000Research*, *12*. https://doi.org/10.12688/f1000research.136339.2

OECD. (2023). *Program For International Student (PISA) 2022 Assessment and Analytical Framework*. Paris: OECD (Organisation for Economic Co-operation and Development) Publishing. Received from https://www.oecd-ilibrary.org/education/pisa-2022-assessment-and-analytical-framework_dfe0bf9c-en

Oktavia, R. S., Harir, A. H., & Rosdiana, L. (2024).

Problem Based Learning: Melatihkan Keterampilan Pemecahan Masalah untuk Meningkatkan Hasil Belajar Peserta Didik pada Materi IPA. *PENDIPA: Journal of Science Education*, *8*(2), 171–175. https://doi.org/10.33369/pendipa.8.2.171-175

Pitaloka, E. D., & Suyanto, S. (2019). Keefektifan Blended - Problem Based Learning Terhadap Pemecahan Masalah pada Materi Ekologi. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, *4*(5), 640–647. https://doi.org/10.17977/jptpp.v4i5.12430

Pollock, A., & Berge, E. (2018). How to Do A Systematic Review. *International Journal of Stroke*, *13*(2), 138–156. https://doi.org/10.1177/1747493017743796

Polya. (1973). *How To Solve It*. United States of America: Princeton University Press.

Pucangan, A. A. S. N. A., Handayanto, S. K., & Wisodo, H. (2018). Pengaruh Scaffolding Konseptual dalam Problem Based Learning Terhadap Kemampuan Pemecahan Masalah. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, *3*(10), 1314–1318. https://doi.org/10.17977/jptpp.v3i10.11661

Rahayu, N. W. B., Suma, K., & Arnyana, I. B. P. (2018). Pengaruh Model Pembelajaran Kooperatif Tipe Scramble Berbantuan LKS Terhadap Hasil Belajar IPA. *Jurnal Pendidikan dan Pembelajaran IPA Indonesia*, *8*(1), 36–45. https://doi.org/10.23887/jppp.v2i3.16282

Rasyid, F. (2022). *Metodologi Penelitian Kualitatif dan Kuantitatif Teori, Metode, dan Praktek*. Jawa Timur: IAIN Kediri Press.

Rukminingsih, R., Adnan, G., & Latief, M. A. (2020). *Metode Penelitian Pendidikan*. Yogyakarta: Erhaka Utama.

Saputri, D. A., & Febriani, S. (2017). Pengaruh Model Problem Based Learning (PBL) Terhadap Kemampuan Pemecahan Masalah Peserta Didik pada Mata Pelajaran Biologi Materi Pencemaran Lingkungan Kelas X Mia SMA N 6 Bandar Lampung. *Biosfer: Jurnal Tadris Biologi*, *8*(1), 40–52. https://doi.org/10.24042/biosf.v8i1.1262

Sari, I. N., Mahanal, S., & Prabaningtyas, S. (2024). The Complexity science Problem-Based Learning : Correlation of Science Literacy and Concept Mastery to Problem-Solving Skills. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, *10*(3), 920–927. https://doi.org/10.22219/jpbi.v10i3.35793

Sarkity, D., Yuliati, L., & Hidayat, A. (2018). Kemampuan Siswa dalam Memecahkan Masalah Momen Gaya Melalui Pembelajaran Berbasis Masalah. *Jurnal Pendidikan Teori Penelitian dan Pengembangan*, *3*(2), 195–199. https://doi.org/10.17977/jptpp.v3i2.10509

Sepriyani, S., Asyhar, R., & Asrial, A. (2018). Pengaruh Model Pembelajaran Problem Based Learning dan Gaya Kognitif Terhadap Hasil Belajar IPA Siswa di Kelas VII MTSN 2 Tanjung Jabung Timur. *Edu-Sains: Jurnal Pendidikan Matematika dan Ilmu Pengetahuan Alam*, *7*(1), 1–7. https://doi.org/10.22437/jmpmipa.v7i1.7276

Simanjuntak, M., Hutahaean, J., Marpaung, N., & Ramadhani, D. (2021). Effectiveness of Problem-Based Learning Combined with Computer Simulation on Students' Problem-Solving and Creative Thinking Skills. *International Journal of Instruction*, *14*(3), 519-534. https://doi.org/10.29333/iji.2021.14330a

Snyder, H. (2019). Literature Review as a Research Methodology: An Overview and Guidelines. *Journal of Business Research*, *104*(August), 333–339. https://doi.org/10.1016/j.jbusres.2019.07.039

Sujarwo, D. T. (2020). Pengaruh Problem Based Learning Terhadap Kemampuan Pemecahan Masalah dan Self Efficacy Siswa Kelas VIII SMP Negeri 1 Patikraja. *AlphaMath: Journal of Mathematics Education*, *6*(1), 46–54. https://doi.org/10.30595/alphamath.v6i1.7948

Sumiantari, N. L. E., Suardana, I. N., & Selamet, K. (2019). Pengaruh Model Problem Based Learning Terhadap Kemampuan Pemecahan Masalah IPA Siswa Kelas VIII SMP. *Jurnal Pendidikan dan Pembelajaran Sains Indonesia (JPPSI)*, *2*(1), 12. https://doi.org/10.23887/jppsi.v2i1.17219

Sunaryo, Y. (2017). Pengukuran Self-Efficacy Siswa dalam Pembelajaran Matematika di Mts N 2 Ciamis. *TEOREMA: Teori dan Riset Matematika*, *1*(2), 39. https://doi.org/10.25157/teorema.v1i2.548

Susetyarini, E., & Fauzi, A. (2020). Trend of Critical Thinking Skill Researches in Biology Education Journals Across Indonesia: From Research Design to Data Analysis. *International Journal of Instruction*, *13*(1), 535–550. https://doi.org/10.29333/iji.2020.13135a

Wahyuni, A. S., & Miterianifa, M. (2019). Desain Lembar Kerja Peserta Didik Berbasis Problem Based Learning untuk Meningkatkan Self-Efficacy Peserta Didik. *JTK (Jurnal Tadris Kimiya)*, *4*(1), 78–90. https://doi.org/10.15575/jtk.v4i1.4240

Wang, Y., Xu, Z., Lou, J., & Chen, K. (2023). Factors Influencing the Complex Problem-Solving Skills in Reflective Learning: Results from Partial Least Square Structural Equation Modeling and Fuzzy Set Qualitative Comparative Analysis. *BMC Medical Education*, *23*, 382. https://doi.org/10.1186/s12909-023-04326-w

Yasin, M., & Novaliyosi, N. (2023). Systematic Literature Review: Integrasi Model Problem Based Learning dengan Media Pembelajaran dalam Peningkatan Kemampuan Pemecahan Masalah. *Jurnal Lebesgue: Jurnal Ilmiah Pendidikan Matematika, Matematika dan Statistika*, *4*(2), 728–747.

https://doi.org/10.46306/lb.v4i2.323
Yulita, R., & Defrinal, D. (2024). Peranan Self Efficacy dalam Meningkatkan Minat Belajar. *Journal of Learning and Teaching*, *2*(1), 9–15. https://doi.org/10.70692/p1a0zq35
Zebua, L., Harefa, A. R., Telaumbanua, D., & Waruwu, T. (2025). Pengaruh Modul Ajar IPA Berbasis Problem Based Learning Terhadap Kemampuan Pemecahan Masalah Siswa Kelas IX SMP Negeri 4 Mandrehe Utara. *Jurnal Pendidikan, Sains dan Teknologi*, *12*(2), 592–611. https://doi.org/10.47668/edusaintek.v12i2.1720
Zen, Z., Reflianto, R., Syamsuar, S., & Ariani, F. (2022). Academic Achievement: The Effect of Project-Based Online Learning Method and Student Engagement. *Heliyon*, *8*(11), e11509. https://doi.org/10.1016/j.heliyon.2022.e11509
Zhong, J., Ismail, L., & Lin, Y. (2025). Investigating EFL Students' Engagement in Project-Based Speaking Activities: From A Multi-Dimensional Perspective. *Frontiers in Psychology*, *16*. https://doi.org/10.3389/fpsyg.2025.1598513