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Systematic Literature Review on Learning Outcomes Based on PBL Effectiveness Assisted By LMS

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Abstract
This study aims to analyze the effectiveness of Problem-Based Learning (PBL), Learning Management Systems (LMS), and the integration of the two on student learning outcomes through a systematic literature review. A total of 24 articles were analyzed, obtained from the Scopus and Google Scholar databases based on established inclusion criteria. The synthesis results indicate that PBL tends to have a positive impact on student learning outcomes, particularly in cognitive aspects such as critical thinking and problem-solving skills, although the reported levels of effectiveness vary. The use of LMS serves as a support system that facilitates more structured and interactive learning; however, it does not directly act as the primary factor determining learning success. The integration of PBL and LMS demonstrates potential in enhancing learning outcomes and supporting skills, but has not consistently proven superior compared to the separate implementation of PBL or learning technology. Furthermore, the variations in effectiveness reported in the literature are influenced by the interaction of various factors, including both internal factors such as self-regulation and student engagement, and external factors such as instructional design and technology implementation. This study contributes a comprehensive synthesis of the effectiveness of PBL, LMS, and their integration, and highlights the importance of understanding the conceptual differences between LMS and e-learning when interpreting research results.
Keywords: *Problem-Based Learning, Learning Management System, Learning Outcomes, Systematic Literature Review*

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INTRODUCTION

The contemporary educational landscape has undergone fundamental changes due to the rapid and inevitable integration of digital tools into everyday pedagogical frameworks. As noted by Hutasuhut and Harahap (2024), the influence of technology is no longer merely a peripheral or optional addition to the classroom; rather, it has become a key determinant of educational outcomes and modern teaching practices. This shift necessitates a practical re-evaluation of how traditional classrooms operate, moving toward a digital environment where technology serves as the primary catalyst for teaching excellence, rather than merely an additional resource. Consequently, educational institutions are increasingly pressured to align their teaching strategies with the technology-driven demands of society to ensure that students remain competitive and adaptable in an ever-evolving global market.

Technology plays a fundamental role as a medium for delivering content and is used to provide educators with advanced data-driven mechanisms to monitor student progress and provide personalized feedback in real time. According to Shihab et al. *(*2023), these digital capabilities are essential for bridging the gap between abstract concepts in the classroom and the complex nature of real-world challenges. When utilized effectively, these tools actively foster essential 21st-century competencies, such as critical thinking, creative problem-solving, and the ability to collaborate within a digitized social framework. By providing a platform for the development of these skills, technology ensures that the learning process is not only more efficient but also more meaningful and aligned with the realities of modern professional life.

The path toward full technology integration undoubtedly requires a resilient and proactive attitude from teachers who must remain innovative while seeking creative solutions through technology-based lesson plans (Celeste & Osias, 2024). Despite this potential, continued reliance on

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traditional teacher-centered models often results in a lack of student engagement, which ultimately hinders the development of higher-order cognitive skills. Simanjuntak et al. (2021) argue that in the context of the Fourth Industrial Revolution, effective learning must be redefined based on the ability to address unexpected demands through critical competencies, rather than merely memorizing facts. This pedagogical gap highlights the urgent need for teaching models that can transform students from passive recipients into active problem-solvers.

Problem-Based Learning (PBL) has emerged to address these challenges and as a superior alternative to conventional rote-learning methods. Historically, as cited in Sari et al. (2021), PBL was first implemented at the Faculty of Medicine at McMaster University in Canada in 1970 to go beyond the mere delivery of lecture material. The primary goal of this model remains the development of critical thinking and independent learning skills essential for long-term academic success. The PBL approach, which engages students in authentic real-world problems, shifts the focus of education toward the development of deeper creative thinking. This model empowers students to fully take charge of their learning journey while preparing them to solve the multifaceted problems they will face in the 21st-century workplace.

The success of PBL lies in its unique educational approach, which helps students identify problems based on real-world situations while gathering information through strategies they develop themselves (Timor et al., 2021). Students arrive at innovative solutions, which they then present through practical demonstrations, making the learning experience tangible and relevant. According to Evendi and Verawati (2021), the PBL model is highly recommended because it consistently improves student learning outcomes, provided that teachers prioritize motivation and implement effective scaffolding throughout the inquiry process. However, managing the complexity of PBL in a traditional setting can be challenging, and this is where the role of a Learning Management System (LMS) becomes crucial as a form of digital scaffolding.

According to Bradley (2021), an LMS is an online platform designed to enhance the teaching and learning process by fostering an inclusive environment through discussion and collaborative group work. This platform empowers students to become more independent by allowing them to effectively track their own assignments and progress. Additionally, Aulianda et al. (2023) emphasize that LMSs enhance the educational experience by centralizing the management, delivery, and reporting of instructional materials. Recent evidence suggests that the synergy between specific pedagogical models and digital infrastructure is key to success in the modern era. For example, Rizal et al. (2021) highlight that integrating Problem-Based Learning (PBL) with an LMS can significantly improve students' digital literacy and broader learning outcomes. This integration is further illustrated by Sari et al. (2022), who demonstrate that problem-based electronic modules within an LMS are highly effective for delivering complex content and enhancing student performance.

Learning outcomes describe what students have actually acquired after the learning process is complete, which is typically assessed through evaluation activities (Sarumaha et al., 2022). Low student achievement is often caused by many factors, including internal and external factors, where internal factors may include behavior, learning motivation, interests, knowledge, skills, and goals, while external factors may include the learning environment, family environment, and the availability of learning facilities and infrastructure.

Various studies have examined the effectiveness of Problem-Based Learning (PBL) and the use of Learning Management Systems (LMS) in education; however, most studies still treat the two separately. Systematic reviews that analyze the integration of PBL and LMS against various learning outcome indicators remain limited. Additionally, there is inconsistency in the definition and implementation of LMS, with some studies still equating LMS with general e-learning platforms. This situation makes it difficult to comprehensively identify the specific contributions of LMS in supporting the effectiveness of PBL-based learning. Furthermore, the effectiveness of PBL integrated with LMS is not only reflected in direct improvements in learning outcomes but is also linked to

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increased student engagement and motivation, which are closely related to academic achievement. Given this gap, this study contributes a comprehensive synthesis comparing the effectiveness of PBL, LMS, and their integration on learning outcomes. Furthermore, this study identifies the internal and external factors influencing the variations in effectiveness reported in the literature.

Therefore, this study aims to systematically analyze the effectiveness of PBL, LMS, and their integration on student learning outcomes based on the available literature. Specifically, this study is formulated into the following research questions:

1. What are the trends in the effectiveness of Problem-Based Learning (PBL) on student learning outcomes based on the analyzed literature?
2. What is the role of the Learning Management System (LMS) in supporting the learning process and student learning outcomes in various learning contexts?
3. What are the patterns of effectiveness of the integration of PBL and LMS compared to the separate implementation of PBL or learning technology?
4. What factors are reported in the literature as influencing variations in the effectiveness of PBL, LMS, and their integration on learning outcomes?

RESEARCH METHODOLOGY

Research Design

This study employs a Systematic Literature Review (SLR) to examine previous research on the effectiveness of Problem-Based Learning (PBL) supported by a Learning Management System (LMS) on student learning outcomes. Through this method, the researcher identifies, evaluates, and synthesizes findings based on systematically formulated research questions. This approach emphasizes careful literature analysis to gain a comprehensive understanding of the state of knowledge in this field (Akmal et al., 2025)

To ensure a structured and accountable process, this study follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. PRISMA ensures that the review process is objective, focused, and replicable by other researchers (Safira, 2026). According to Karlina and Lismayanti (2026), this procedure involves four main stages: identification, screening, eligibility assessment, and inclusion.

Data Sources and Search Strategy

The data sources for this study were scientific articles obtained from Scopus and Google Scholar. The search was conducted on March 27, 2026, using the Publish or Perish (PoP) software to extract metadata based on predefined keywords. The use of PoP was limited to retrieving relevant articles without involving citation metric analysis. The articles were restricted to publications from 2021 to 2026 to represent the latest developments in digital learning.

The literature search used a combination of Boolean operators. In Scopus, the search string is:

(“*Problem-Based Learning” OR “PBL” AND “Learning Management System” OR “LMS” OR “e-learning” OR “online learning” AND “learning outcomes” OR “student achievement” OR “academic performance*”).

In Google Scholar, variations of keywords such as *Problem-Based Learning, LMS, and Learning Outcomes* were applied to broaden the scope while maintaining relevance.

Inclusion and Exclusion Criteria

A set of criteria has been established to screen results before selecting the final articles. These criteria help ensure that only studies directly relevant to the research objectives are included. Inclusion criteria are the requirements an article must meet to be included in the review, while exclusion criteria

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are the reasons for excluding an article (for example, if full-text access is unavailable or the article has not undergone peer review).
Details of these criteria can be found in the table below:

Table 1. Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclusion
Topic	Studies discussing PBL implementation integrated with an LMS or online platform.	Articles unrelated to PBL or LMS; studies focusing on only one variable without connecting to outcomes.
Measurement	Studies that explicitly measure student learning outcomes (cognitive or non-cognitive).	Articles that do not provide clear data or measurements on student achievement.
Publication Type	Peer-reviewed scientific journals.	Non-peer-reviewed documents, such as conference proceedings, posters, or book chapters.
Publication Year	Published between 2021 - 2026.	Articles published before 2021.
Access	Full-text available.	Abstract-only or restricted access articles.

Article Selection and Data Extraction

The selection process followed the PRISMA steps: identification, screening, eligibility, and inclusion. The final inclusion stage consisted of a limited number of articles due to strict criteria regarding the simultaneous use of PBL and LMS. All selected articles are documented in a PRISMA Flowchart.

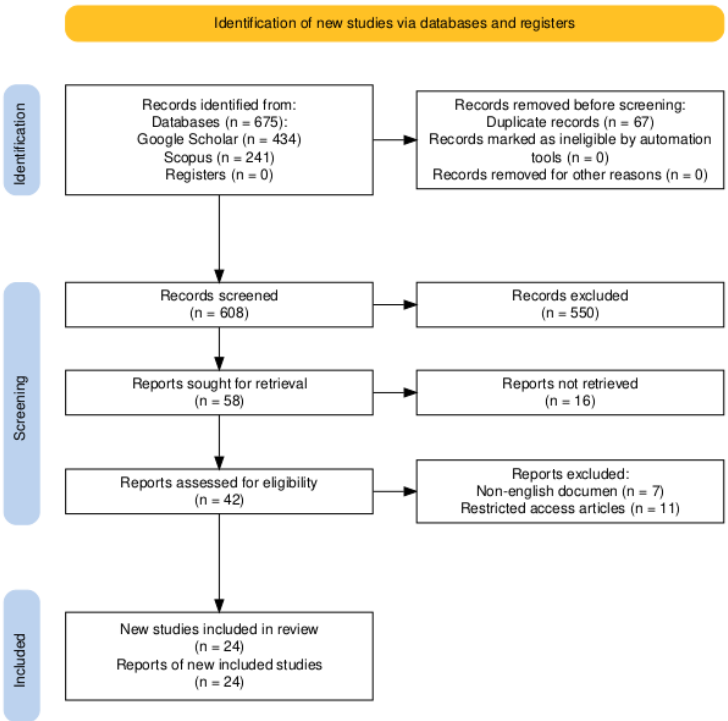


Figure 1. Article Selection Prism Diagram

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For data extraction, researchers identified key information such as author, year, objectives, methods, focus of PBL-LMS implementation, and key findings related to learning outcomes. This data was compiled into a synthesis table for systematic comparison.

Data Analysis Technique

Data analysis was conducted using a qualitative descriptive approach. The articles were analyzed to evaluate the effectiveness of the PBL-LMS model and the factors influencing learning outcomes. This process involved coding and grouping the findings into cognitive (knowledge) and non-cognitive (motivation/engagement) aspects. The results were presented through narrative descriptions and summary tables to provide a comprehensive overview of the research topic.

RESULT AND DISCUSSION

Result

To illustrate the development of research on the implementation of Problem-Based Learning (PBL) supported by a Learning Management System (LMS), an analysis was conducted on the number of scientific publications between 2021 and 2026. The results of this analysis are presented in Figure 2.

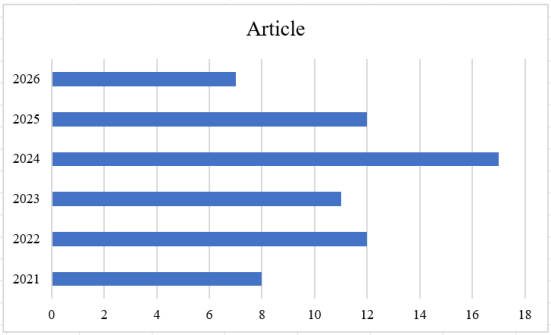


Figure 2. Annual Scientific Production 2021 – 2026

Based on the data mapping in Figure 2, it is evident that researchers' interest in the topic of LMS-supported PBL has fluctuated but generally increased over the past five years. During the initial period from 2021 to 2023, the number of publications remained very low and stable. However, entering 2024, an increase in the number of articles began to emerge, which then surged dramatically, reaching its peak in 2025. Although the data for 2026 appears to be declining, this is due to the ongoing data collection period (mid-year). Overall, this trend indicates that the integration of technology into problem-based learning models is currently a highly relevant and trending topic in the world of education.

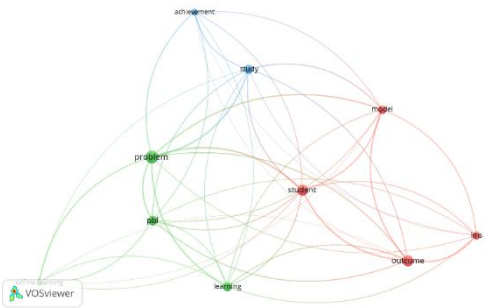


Figure 3. Network Visualization

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Based on the results of the network visualization in Figure 3, it is evident that the keywords "problem-based learning," "learning management system," and "learning outcomes" form the core of the research ecosystem. These three variables have the largest node sizes, indicating a very high intensity of discussion. Interestingly, supporting clusters have emerged that link PBL to specific technological contexts such as "online learning" and "e-learning." This demonstrates that over the past five years, the implementation of PBL has become inseparable from LMS-based infrastructure in efforts to improve student learning outcomes.

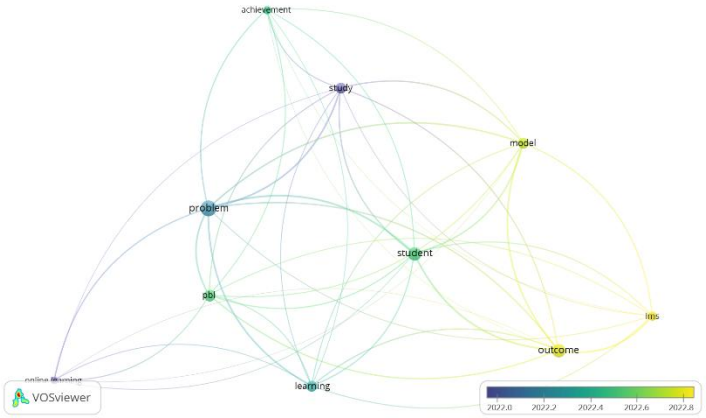


Figure 4. Overlay Visualization

As seen in the Overlay Visualization in Figure 4, there has been a shift in research trends over time. Topics related to general learning outcomes (achievement) tend to appear in older literature. Meanwhile, keywords in brighter colors (yellow/light green) such as 'digital literacy,' 'higher-order thinking skills' and 'critical thinking' indicate the latest research trends (2024–2026). This demonstrates that the focus of recent research has shifted; it is no longer merely about measuring academic scores but has begun to delve into 21st-century skills fostered through technology-based PBL.

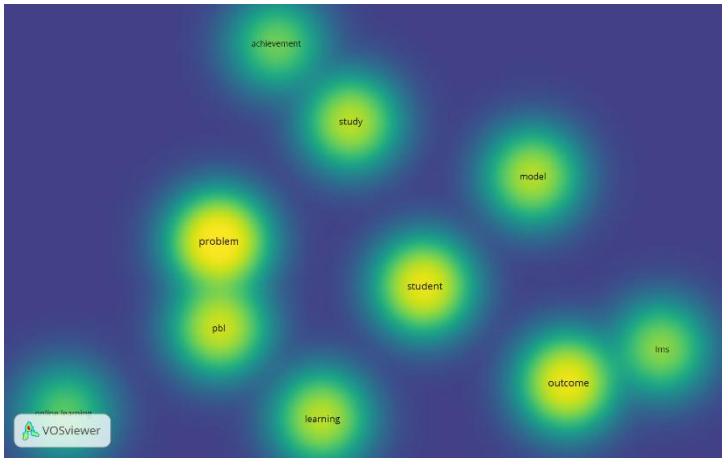


Figure 5. Density Visualization

The density visualization in Figure 5 shows a highly concentrated area of bright yellow at the "learning outcomes" and "PBL" nodes. This confirms that these two topics have reached a state of saturation due to extensive research. On the other hand, areas that appear dimmer or are located on the periphery of the research network still offer opportunities for future researchers. This gap indicates

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that although PBL-LMS is already popular, exploration of certain supporting variables is still relatively rare.

Table 2. Synthesis of Research Findings Related to LMS-Assisted PBL

Study (Author, Year)	Intervention Type	Outcome Measured	Key Findings
Timor et al. (2021)	PBL (pre-experimental)	Learning outcomes, motivation, response	PBL showed significant improvement, but absence of control group limits causal interpretation
Yanto et al. (2021)	PBL (experimental)	Problem-solving skills, knowledge	PBL demonstrated a significant enhancement in students' problem-solving abilities and knowledge compared to conventional instruction
Loppies et al. (2021)	PBL (online)	Cognitive learning outcomes	Online-based PBL significantly increased students' cognitive learning outcomes relative to traditional learning approaches
Aslan (2021)	PBL (online)	Achievement, problem-solving, communication	PBL improved learning achievement and problem-solving skills significantly, although no significant effect was found on communication skills
Safitri et al. (2023)	PBL (quasi-experimental)	Learning outcomes, motivation	The use of PBL led to higher learning outcomes and motivation, though the level of effectiveness remained moderate (N-gain = 0.65)
Aristin et al. (2023)	PBL (blended/online)	Learning outcomes (HOTS)	PBL contributed to improved higher-order thinking skills; however, the effectiveness was categorized as moderate (N-gain ≈ 69%)
Zhang (2023)	Web-based PBL	Learning outcomes, gender differences	Web-based PBL outperformed conventional learning significantly, with male students achieving higher final scores, indicating gender-related differences
Alshaye et al. (2023)	Online PBL (Facebook Groups)	Problem-solving ability (PSA), programming skills	The use of PBL through social media platforms enhanced higher-order thinking and programming skills via collaborative interaction
Munawaroh et al. (2022)	E-PBL	Motivation, interest, achievement	E-PBL positively affected motivation, interest, and achievement, with affective factors playing a role in supporting cognitive outcomes
Wang et al. (2023)	Online PBL + analytics	Performance, engagement, self-regulation	Student performance was more strongly influenced by self-regulation and engagement than by instructional design alone

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Study (Author, Year)	Intervention Type	Outcome Measured	Key Findings
Saqr et al. (2023)	Tech-supported PBL	Learning strategies, academic achievement	Students applying deep learning strategies achieved higher academic performance, with strategy transfer identified as a key success factor
Nácher et al. (2021)	GoKoan e-learning platform	Academic performance	The use of an e-learning platform produced a positive impact on academic performance (d = 0.39) by improving study efficiency
Alneyadi et al. (2023)	Smart e-learning apps (Alef, Connect)	Scientific concept achievement	Smart learning applications significantly improved students' understanding of scientific concepts compared to traditional methods
Ratnasari et al. (2025)	PBL + LMS (Google Sites)	Learning outcomes	Students exposed to PBL supported by LMS achieved higher post-test scores than those in the control group
Ramdhani et al. (2021)	PBL + LMS (CAR design)	Critical thinking, problem-solving, communication	LMS-integrated PBL improved higher-order thinking skills, while communication was supported through discussion features; however, no control group was used
Febrianto et al. (2021)	PBL-STEM + LMS	Critical thinking, learning outcomes	The combination of PBL-STEM and LMS resulted in moderate improvement in critical thinking (N-gain = 0.46), with limitations in higher-order inference
Rizal et al. (2021)	PBL + LMS (development)	Digital literacy	The developed LMS-based PBL significantly enhanced students' digital literacy, as indicated by statistical testing ($p < 0.05$)
Maksum et al. (2025)	PBL + e-learning	Performance, satisfaction, teamwork	The integration of PBL with e-learning improved academic performance, student satisfaction, and collaborative skills
Yustina et al. (2022)	PBL + e-learning	Creative thinking	PBL implemented through e-learning significantly enhanced creative thinking, particularly in originality and elaboration aspects
Phunaploy et al. (2021)	PBL + cloud learning	Analytical thinking, achievement	PBL supported by cloud learning significantly improved analytical thinking and academic achievement ($p < 0.01$)
Theabthuen g et al. (2022)	PBL + Think-Pair-Share	Analytical thinking, achievement	The integration of PBL with Think-Pair-Share effectively increased analytical thinking and academic achievement
Sabil et al. (2021)	PBL + scaffolding	Learning outcomes, independence	PBL combined with scaffolding techniques improved both learning outcomes and student independence significantly

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Study (Author, Year)	Intervention Type	Outcome Measured	Key Findings
Dalila et al. (2022)	PBL + differentiation	Cognitive outcomes	Differentiated PBL produced greater learning gains (N-gain = 0.81) compared to standard PBL (0.42)
Thamrin et al. (2022)	PBL + cognitive style variation	Learning outcomes	Learning outcomes were influenced by both PBL implementation and students' cognitive styles, indicating interaction effects between pedagogy and learner characteristics

The synthesis results in Table 1 show that the 24 articles analyzed varied in terms of intervention type, research design, and outcome variables examined. The interventions examined included standalone Problem-Based Learning (PBL), digital platform-based PBL, and PBL integrated with a Learning Management System (LMS).

Most studies employed a quantitative approach using experimental and quasi-experimental designs, while others utilized pre-experimental or developmental designs. The outcome variables measured included cognitive aspects such as learning outcomes, higher-order thinking skills, and problem-solving skills. Some studies also reported on affective aspects such as motivation and engagement, as well as additional variables such as digital literacy and self-regulation.

Discussion

This discussion is based on a synthesis of 24 articles obtained through a systematic literature review of the Scopus and Google Scholar databases. The analyzed articles include studies examining the implementation of Problem-Based Learning (PBL), Learning Management Systems (LMS), and the integration of both, in relation to various indicators of student learning outcomes. In this study, the term "learning outcomes" encompasses various indicators such as academic achievement, thinking skills, and students' affective aspects.

The Effectiveness of Problem-Based Learning (PBL) on Student Learning Outcomes

Regarding the first research question (RQ) on the effectiveness of PBL on learning outcomes, the synthesis results indicate that the implementation of PBL tends to have a positive impact, although the level of effectiveness varies depending on implementation conditions. The problem-based learning (PBL) approach is rooted in the "learning by doing" concept, which emphasizes students' active engagement in the learning process. This model was first developed in medical education to foster critical thinking and problem-solving skills through the presentation of contextual problems (Jaganathan et al., 2024; Lin, 2026). Conceptually, the effectiveness of PBL can be explained through a constructivist perspective, particularly Piaget's theory of cognitive development, which views learning as an active process of constructing knowledge (Pitriani et al., 2023), as well as Vygotsky's theory of social constructivism, which emphasizes the importance of interaction and scaffolding in helping students reach their zone of proximal development (Mishra, 2023; Wibowo et al., 2025)

A synthesis of the 24 articles in Table 1 shows that, for the most part, the implementation of PBL tends to have a positive impact on student learning outcomes, particularly in cognitive aspects. This improvement is evident in various indicators such as learning outcomes, knowledge, and problem-solving skills compared to conventional learning (Loppies et al., 2021; Timor et al., 2021; Yanto et al., 2021). Similar findings were also observed in the context of online and blended learning, indicating that PBL remains relevant across various learning environments (Aristin et al., 2023; Aslan, 2021; Zhang, 2023). These findings largely stem from studies with experimental and quasi-

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experimental designs, although some studies still have methodological limitations, such as the absence of a control group.

The reported effectiveness of PBL is not consistent. Some studies measure improvements in learning outcomes using indices such as N-gain, which indicate that the resulting improvements generally fall into the moderate category, such as an N-gain score of 0.65 (Safitri et al., 2023) and approximately 0.69 (Aristin et al., 2023). This indicates that while PBL is effective in improving learning outcomes, the extent of improvement is not always high and is highly dependent on implementation conditions. Furthermore, not all learning outcome indicators show significant improvement; for instance, communication aspects in online learning were reported to show no significant difference (Aslan, 2021). Therefore, the effectiveness of PBL must be understood contextually and cannot be generalized absolutely.

In addition to cognitive aspects, the implementation of PBL also contributes to students' affective aspects. Several studies have shown an increase in motivation, interest in learning, and student engagement during the learning process (Alshaye et al., 2023; Munawaroh et al., 2022). This indicates that PBL does not merely focus on academic outcomes but also fosters students' active engagement in the learning process. Nevertheless, learning outcomes in PBL-based instruction are not solely determined by the instructional model itself but are also influenced by various supporting factors. Research indicates that students' levels of engagement and self-regulation play a significant role in determining learning success (Wang et al., 2023). Additionally, the learning strategies employed by students, particularly deep learning strategies, also contribute to achieving more optimal learning outcomes (Saqr et al., 2023). Other factors, such as individual student characteristics—including cognitive styles—also influence the effectiveness of PBL in enhancing learning outcomes (Thamrin et al., 2022).

PBL is known to have strong potential for improving student learning outcomes, both in cognitive and affective aspects. However, this effectiveness is not universal and depends heavily on implementation conditions, student characteristics, and other supporting factors in the learning process. Nevertheless, most of the studies analyzed still focus on general PBL implementation or simple digital-based approaches, so the specific role of more structured learning technologies, such as Learning Management Systems (LMS), in supporting PBL effectiveness still requires further investigation.

The Role of Learning Management Systems (LMS) in the Learning Process

In response to the second research question regarding the role of LMS in learning, the analysis results indicate that LMS serves as a support system that facilitates a more structured learning process (Niam et al., 2025; Ramdhani et al., 2021). Advances in digital technology have driven changes in the teaching and learning process, one of which is through the use of a Learning Management System (LMS). A Learning Management System (LMS) is a platform that provides an integrated system for the learning process, enabling collaboration and the sharing of educational materials among teachers, students, and institutional administrators. According to Kurniawan et al. (2022) and Prahani et al. (2022), LMS has become a key focus across various levels of education due to its ability to support the implementation of digital learning in a more structured manner.

LMS functions not only as a medium for delivering content but also as a system that comprehensively manages the learning process, including content distribution, assignment management, and interactions between teachers and students. Niam et al. (2025) emphasize that LMSs contribute to enhancing learning effectiveness by supporting interaction, collaboration, and monitoring of student learning activities; thus, an LMS can be defined as a digital learning environment that not only conveys information but also facilitates the learning process in a more systematic manner.

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The findings presented in Table 1 indicate that the use of LMS in various learning contexts tends to have a positive impact on student learning outcomes. Several studies report improvements in cognitive aspects, such as learning outcomes and higher-order thinking skills (Ramdhani et al., 2021; Ratnasari et al., 2025). On the other hand, the use of LMS is also associated with improvements in students' digital literacy (Rizal et al., 2021). This pattern suggests that LMS has the potential not only to support academic achievement but also to foster skills relevant to learning in the digital age.

When compared to the use of digital learning technologies in general, such as e-learning or web-based platforms, the results indicate a relatively similar trend. Research by Febrianto et al. (2021) and Maksum et al. (2025) demonstrate that the use of digital media can also improve student learning outcomes, collaboration skills, and critical thinking abilities. This suggests that improved learning outcomes are not solely due to the use of LMS as a platform but are also influenced by the instructional design implemented.

Not all studies in Table 1 use the term "LMS" in the same sense. In some of the studies analyzed, the term "LMS" is not always used consistently. A number of studies categorize e-learning platforms or general web-based media as part of an LMS, even though conceptually the two differ in terms of system integration and learning management features. This is evident in several studies that used general digital platforms yet still associated them with improved learning outcomes (Febrianto et al., 2021; Maksum et al., 2025). These differences are not merely technical variations but have the potential to influence interpretations of reported effectiveness. Therefore, the findings regarding the role of LMS must be interpreted with caution, as not all studies represent the use of LMS in a fully structured and integrated sense. Some studies still utilize e-learning or general digital platforms that do not always possess integrated learning management features like those found in LMS. These variations indicate that there are differences in the level of complexity in the use of learning technologies; thus, the contribution of LMSs must be interpreted carefully and should not be equated with all forms of digital learning. Consequently, the distinction between LMSs and e-learning in the literature is not merely technical but also conceptual, and this must be considered when interpreting research findings.

An LMS can be understood as one of the supporting factors in the learning process that plays a role in providing a more flexible, structured, and interactive learning environment. However, an LMS is not directly the primary factor determining student learning success; rather, it depends on how the platform is integrated into the instructional design. This indicates that the effectiveness of an LMS is contextual and influenced by various implementation factors.

The Integration of Problem-Based Learning (PBL) and Learning Management Systems (LMS) and Their Limitations

The third research question examines the effectiveness of integrating PBL and LMS; findings indicate that the combination of the two has the potential to improve learning outcomes, but has not yet consistently demonstrated superiority over other approaches (Ratnasari et al., 2025; Rizal et al., 2021). Much of today's learning combines instructional models with the use of technology, rather than merely using technology as a supporting medium. One widely used approach is the integration of Problem-Based Learning (PBL) with a Learning Management System (LMS). Conceptually, PBL emphasizes problem-solving activities, thereby encouraging active student engagement, while an LMS serves as a system capable of managing the learning process in a structured manner. The combination of the two is often assumed to enhance learning effectiveness by integrating pedagogical aspects with technological support.

Based on the research findings in Table 1, there are several studies that directly examine the implementation of LMS-supported PBL. Ratnasari et al. (2025) reported that the use of a Google Sites-based LMS in problem-based learning is associated with improved student learning outcomes. Similar findings were also presented by Ramdhani et al. (2021), who demonstrated an improvement

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in critical thinking skills through the implementation of PBL supported by an LMS. Additionally, Rizal et al. (2021) revealed that the integration of an LMS into PBL-based learning contributes to enhancing students' digital literacy. These results indicate that the combination of PBL and LMS has the potential to support various aspects of learning outcomes, including both cognitive and supporting skills.

When the LMS was compared with other studies in the table that used learning technologies more generally, the observed improvement patterns did not fully indicate significant differences. Maksum et al. (2025) reported that the implementation of e-learning in education was also able to improve students' academic performance and collaboration skills. Furthermore, Febrianto et al. (2021) also demonstrated that the use of digital learning platforms in a STEM-based learning context contributes to improved critical thinking skills. The similarity in these patterns suggests that improvements in learning outcomes are likely influenced not only by the use of the LMS as a system but also by the effectiveness of the learning approaches employed, particularly PBL.

The ways in which LMSs were implemented in the studies analyzed varied. Some findings treat LMS as a structured system with comprehensive features, while other studies still categorize the use of general digital platforms as part of an LMS (Febrianto et al., 2021; Maksum et al., 2025). This discrepancy blurs the line between LMS and other learning technologies, making it difficult to identify the specific contributions of LMS to learning outcomes. The success of PBL and LMS integration from an implementation perspective is also influenced by other factors, such as student engagement levels, self-regulation skills, and the design of the learning activities implemented. This indicates that while LMS can support the implementation of PBL, its role is more that of a facilitator rather than a primary factor directly determining learning outcomes.

The overall integration of PBL and LMS does indeed show potential for creating more active, structured, and flexible learning. However, based on the available evidence, it cannot yet be concluded that the combination of the two consistently yields superior results compared to the use of PBL or learning technology separately. In other words, the effectiveness of this integration remains context-dependent and relies on various supporting factors. Based on this analysis, several significant research gaps can be identified. First, the number of studies specifically examining the integration of PBL and LMS remains limited compared to research addressing them separately. Second, the lack of consistency in the definition and implementation of LMS makes it difficult to directly compare research findings. Therefore, further research with more controlled and focused designs is needed to analyze the specific roles of each component in enhancing learning outcomes.

Factors Influencing the Effectiveness of PBL, LMS, and Their Integration

Regarding the fourth research question concerning the factors reported in the literature as influencing variations in the effectiveness of PBL, LMS, and their integration on learning outcomes, the synthesis results indicate that these factors are not singular but can be classified into internal and external factors.

Several studies indicate that learning success correlates with students' internal factors, particularly levels of engagement and self-regulation (Wang et al., 2023). In addition to these factors, other literature identifies that students who employ deep learning strategies tend to demonstrate higher academic achievement, especially when they can transfer learning strategies across various learning contexts (Saqr et al., 2023). Individual characteristics are also reported to be associated with variations in learning outcomes, such as the interaction between the PBL model and students' cognitive styles (Thamrin et al., 2022), as well as gender differences in web-based learning contexts (Zhang, 2023).

Several studies indicate that external factors, particularly instructional design in integrating technology into learning activities, contribute to the effectiveness of implementation (Maksum et al., 2025; Wang et al., 2023). Improved learning outcomes are not only associated with the use of an

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LMS as a platform but also with how the technology is utilized pedagogically. Alignment with student needs, implementation conditions, and the context of the learning material are also reported to influence the outcomes achieved.

The use of learning technologies in general, such as e-learning or other digital platforms, has also been reported to support improved learning outcomes, meaning that the contribution of LMSs does not always stand alone as a single factor (Febrianto et al., 2021; Rizal et al., 2021). Variations in the types and levels of complexity of technology—ranging from general digital platforms to more integrated LMSs—also suggest they may contribute to the differences in learning outcomes reported in the literature (Alneyadi et al., 2023; Nácher et al., 2021).

Internal and external factors do not operate in isolation but interact with one another to influence learning outcomes. For example, effective instructional design can enhance student engagement and self-regulation, which ultimately leads to improved learning outcomes. Conversely, the use of technology that is not supported by student readiness and appropriate activity design tends not to yield optimal results.

CONCLUSION

Based on the results of a systematic literature review of 24 articles, it can be concluded that Problem-Based Learning (PBL), Learning Management Systems (LMS), and the integration of both have the potential to improve student learning outcomes, although the reported effectiveness is not absolute and tends to vary. PBL generally shows a tendency to have a positive impact, particularly in enhancing critical thinking skills, problem-solving abilities, and student engagement in the learning process. However, the level of improvement achieved is not always high and depends on implementation conditions and student characteristics.

The use of an LMS serves as a support system that facilitates learning in a more flexible, structured, and interactive manner. Nevertheless, improvements in learning outcomes are not entirely due to the use of the LMS as a technological platform but are influenced by instructional design and implementation methods. Furthermore, variations in the definitions and uses of LMS in the literature indicate that not all studies clearly distinguish between LMS and general e-learning platforms; therefore, the contribution of LMS must be interpreted with caution.

The integration of PBL and LMS shows potential in creating a more active learning environment that supports various aspects of learning outcomes. However, the synthesis results indicate that the combination of the two has not consistently outperformed the separate implementation of PBL or learning technology. This suggests that the effectiveness of such integration depends heavily on the implementation context, including the complexity of the platform used and the design of learning activities.

The variations in learning outcomes reported in the literature result from the interaction between internal and external factors. Internal factors such as self-regulation, engagement, and students' learning strategies play a role in determining learning success, while external factors such as pedagogical design and the appropriateness of technology use also influence the effectiveness of implementation.

Thus, the effectiveness of PBL, LMS, and their integration cannot be understood in isolation but must be viewed as the result of the interaction of various contextual factors. Therefore, learning success is determined not only by the model or technology used but also by how both are appropriately designed and implemented within the learning context.

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