

Systematic Review of PBL–LMS Effects on Critical Thinking and Adversity Quotient in Elementary Education



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Abstract

Despite the increasing emphasis on critical thinking skills and adversity quotient in elementary education, existing studies remain fragmented and lack comprehensive synthesis regarding the integration of instructional models and digital platforms. Specifically, the combination of Problem-Based Learning (PBL) and Learning Management Systems (LMS) has not been systematically examined within elementary mathematics contexts. This study aims to synthesize empirical evidence on the effectiveness of PBL integrated with LMS in enhancing students' critical thinking skills and adversity quotient. This research employs a Systematic Literature Review (SLR) using structured stages: identification, screening, eligibility, and inclusion. A total of 16 peer-reviewed articles published between 2020 and 2025 were selected from Google Scholar and Scopus based on predefined criteria. The analysis focuses on research design, intervention characteristics, and learning outcomes. The findings indicate that PBL–LMS integration effectively promotes critical thinking through problem exploration, collaboration, and reflection. It also strengthens students' adversity quotient by fostering persistence, adaptability, and resilience in learning challenges. Furthermore, its effectiveness is influenced by instructional design quality, digital facilitation, and task alignment with student characteristics. This study contributes a focused synthesis highlighting the dual impact of PBL–LMS integration on cognitive and non-cognitive development in elementary mathematics learning.

Keywords: Problem-Based Learning, Learning Management System, Critical Thinking Skills, Elementary Education

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Introduction

Education plays a crucial role in the development of a nation. High-quality education serves as the foundation for cultivating a generation capable of advancing the country. Education is a conscious and planned effort to create active learning processes that engage students and foster the development of their potential ¹. Through education, individuals are able to continually develop their abilities, improve their behavior, and acquire knowledge over time. As such, education encompasses all aspects that influence the growth, development, and transformation of an individual whether in terms of knowledge, skills, or daily behavior.

In relation to this, strategies for optimizing cognitive development must be emphasized by both educators and learners. A strategy refers to the process of organizing potential and resources to achieve outcomes aligned with planned objectives. Closely related to tactics, strategy involves the optimal utilization of situations and conditions to reach a goal. Conceptually, in the context of teaching and learning, strategy holds philosophical significance. Originally a term used in the military to gain victory, strategy is defined as a method or approach employed to attain objectives or achieve success in an optimal manner ². In today's era of globalization, technology is rapidly evolving. The use of artificial intelligence in daily life is increasing, not only in the business sector but also in education. The integration of technology into educational processes is vital, as it supports the creation of learning environments that are active, creative, and innovative.

Effective learning processes often depend on the implementation of appropriate learning models. In the context of mathematics education, effective learning models are particularly important because mathematics not only requires conceptual understanding but also logical reasoning, analytical skills, and problem-solving abilities. Therefore, selecting the right model, such as Problem-Based Learning (PBL), becomes crucial for promoting students' critical thinking and resilience in solving mathematical problems. One such model is Problem-Based Learning (PBL), which supports the development of students' critical thinking skills. To enhance the effectiveness and engagement of PBL, technology can be integrated into its implementation particularly through the use of Learning Management Systems (LMS).

¹ Desi Pristiwanti et al., "Pengertian Pendidikan," *Jurnal Pendidikan Dan Konseling (JPDK)* 4, no. 6 (2022): 7911–15, <https://doi.org/https://doi.org/10.31004/jpdk.v4i6.9498>.

² Susanti Faipri Selegi et al., *Strategi Pembelajaran* (CV. Azka Pustaka, 2023); Hasriadi Hasriadi, "Strategi Pembelajaran" (Mata Kata Inspirasi, 2022).

An LMS is a technology-based learning platform accessible via computers, mobile devices, or other digital tools. It is defined as a web- or internet-based system that facilitates engaging learning experiences that can be accessed anytime and anywhere ³. LMS platforms can serve as effective tools for implementing the PBL model. For example, educators may incorporate digital platforms such as Quizizz, Wordwall, Khan Academy, Google Classroom, Zoom, YouTube, and others. These platforms enable students to access knowledge in a comprehensive manner and offer various engaging features that help prevent learning from becoming monotonous.

Problem Based Learning (PBL) consists of five distinct stages within its instructional process. According to ⁴ these stages begin with problem-posing and conclude with the presentation of students' work and solutions. The five stages are as follows: 1) Problem Posing, at this stage, the teacher prepares a worksheet containing a contextual problem that students will be required to solve; 2) Learning Organization, the teacher organizes and facilitates the problem-solving process by guiding discussions and helping students analyze the issues presented in the worksheet; 3) Guiding Investigation or Group Work, the teacher supervises students as they work in groups, supports brainstorming activities, and helps them formulate learning objectives; 4) Developing and Presenting Student Work students examine the outcomes of their group discussions and present their findings to the class. The teacher facilitates class-wide discussions to assess and compare group presentations; 5) Analyzing and Evaluating the Problem-Solving Process, in this final stage, the teacher introduces relevant terminologies and concepts, guides students in reflecting on the learning process, and helps synthesize the key ideas covered.

Critical thinking is a fundamental skill that must be cultivated through educational practices. It is one of the primary goals of the learning process. Critical thinking encompasses the ability to regulate one's own cognitive processes, enabling the formulation of interpretations, analyses, and evaluations based on evidence, concepts, and well-reasoned judgments to support decision-making. This skill is increasingly essential in the context of a rapidly evolving globalized world. Critical thinking can be nurtured through interactive

³ Dwi Nila Andriani and Ana Dhaoud Daroin, "Analisis Faktor Keberhasilan Pembelajaran Menggunakan Learning Management System (LMS)," *Jurnal Pendidikan Edutama* 9, no. 1 (2022): 1–10.

⁴ Lestari et al. (2021)

learning environments that actively engage students in the learning process ⁵. the development of critical thinking requires consistent practice, the application of appropriate thinking strategies, and the use of learning models that stimulate cognitive activity.

In addition to critical thinking, Adversity Quotient (AQ) plays a significant role in educational settings. According to ⁶ Adversity Quotient refers to an individual's ability to perceive challenges or difficulties and respond to them effectively using their cognitive and emotional resources. It reflects a person's capacity to persist and succeed in the face of adversity. In other words, AQ represents the resilience and perseverance of learners when confronted with obstacles. Based on the above discussion, this study aims to examine how digital learning platforms and the Problem-Based Learning model can be utilized to enhance students' critical thinking abilities and Adversity Quotient during the learning process. Specifically, this SLR focuses on how PBL and LMS are applied in mathematics learning to enhance critical thinking and the adversity quotient of students at various educational levels.

Based on the study's background and objectives, this Systematic Literature Review (SLR) is guided by four interrelated research questions designed to uncover patterns, relationships, and implications of integrating Problem-Based Learning (PBL) and Learning Management Systems (LMS) in mathematics education. Specifically, the review examines: (1) how PBL is implemented to enhance students' critical thinking skills; (2) the extent to which LMS integration influences both critical thinking and adversity quotient; (3) how the combined use of PBL and LMS contributes to the development of students' resilience and overall learning outcomes in mathematical contexts; and (4) the emerging trends, challenges, and opportunities identified in recent studies published between 2020 and 2025. Collectively, these questions provide a focused analytical framework that not only directs the processes of data identification, selection, and synthesis, but also strengthens the conceptual linkage between cognitive (critical thinking) and non-cognitive (adversity quotient) outcomes within technology-supported, problem-based mathematics learning environments.

⁵ Putri Vadia Dhamayanti, "Systematic Literature Review: Pengaruh Strategi Pembelajaran Inkuiri Terhadap Kemampuan Berpikir Kritis Peserta Didik," *Indonesian Journal of Educational Development (IJED)* 3, no. 2 (2022): 209–19, <https://doi.org/https://doi.org/10.5281/zenodo.7026884>.

⁶ Mayesty et al. (2023)

Research Methods

This study employs a Systematic Literature Review (SLR) method. Accordingly, the researcher reviewed, identified, evaluated, and interpreted published articles from various academic databases.

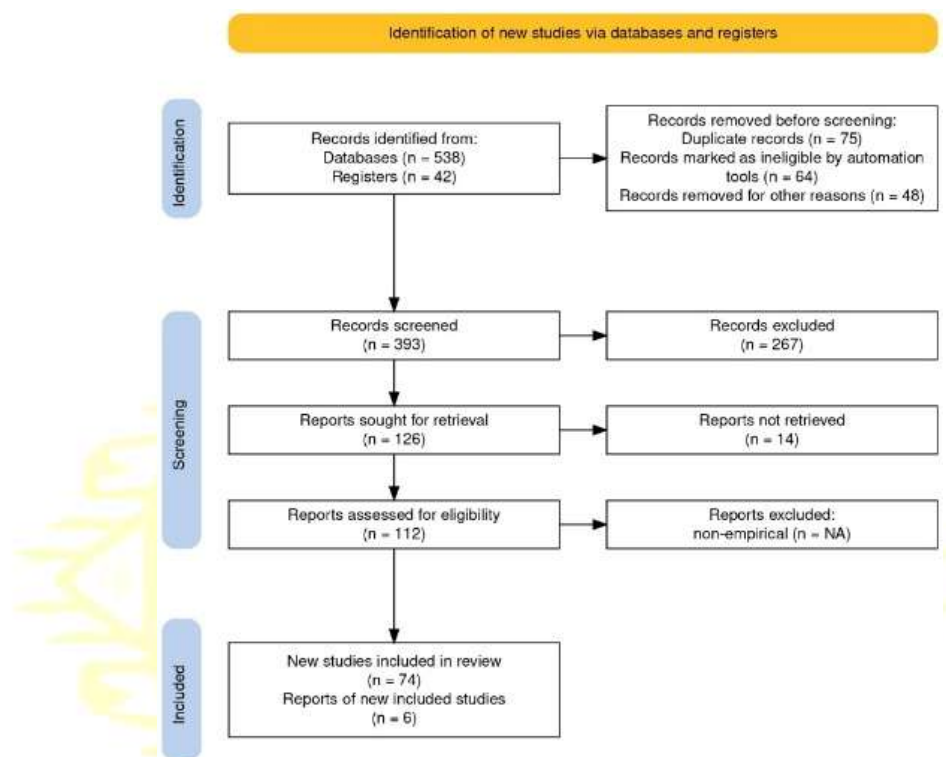


Figure 1. Article Analysis on Critical Thinking Ability, Adversity Quotient, PBL, and LMS

The research process began with the identification of 538 records retrieved from various databases, including Scopus, ScienceDirect, and Google Scholar, using the *Publish or Perish* software. The search employed the main keywords “critical thinking,” “adversity quotient,” “problem-based learning,” and “learning management system”. During the identification stage, 75 duplicate records were removed, along with 64 records deemed ineligible based on the inclusion criteria such as non-journal publications, non-English language sources, or publications outside the 2020–2025 range. After this initial screening, 393 records remained for title and abstract screening. In the screening phase, 267 records were excluded for lacking relevance to the research focus, leaving 126 reports for full-text review. Of these, 14 reports could not be retrieved due to accessibility issues. Subsequently,

112 full-text articles were assessed for eligibility. A total of 38 articles were excluded because they were non-empirical (conceptual or theoretical papers) or did not directly address the key research variables. Finally, 74 studies met all inclusion criteria and were included in the qualitative synthesis of this systematic literature review (SLR).

The majority of the included studies were conducted in the field of mathematics education, spanning primary to tertiary levels. This disciplinary focus provides a more specific understanding of how Problem-Based Learning (PBL) and Learning Management System (LMS) integration fosters the development of students' mathematical reasoning, problem-solving, and higher-order thinking skills. The analysis identified patterns, similarities, and differences across studies, focusing on how the integration of Problem-Based Learning (PBL) and Learning Management Systems (LMS) enhances critical thinking skills and adversity quotient, following PRISMA guidelines to ensure transparency and reproducibility. However, the methodological description remains limited, as key details such as inclusion and exclusion criteria, search strategies, and synthesis techniques are not clearly specified, potentially reducing the review's reproducibility and credibility.

Results and Discussion

Result

In the context of mathematics learning, the use of the PBL model integrated with digital platforms such as Quizizz, Moodle, and Google Classroom has proven effective in developing students' mathematical critical thinking skills. The reviewed studies indicate that mathematical problem-solving activities in a PBL framework foster deeper understanding, persistence, and the ability to connect abstract concepts with real-world contexts.

Critical thinking ability is a fundamental competency in today's globalized era and must be continuously enhanced through educational practice. The implementation of learning models such as Problem-Based Learning (PBL) can provide consistent opportunities for students to develop and practice their critical thinking skills. The rapid advancement of technology presents valuable opportunities for educators to design more engaging learning environments by leveraging digital platform commonly referred to as Learning Management Systems (LMS). The integration of LMS into PBL can create dynamic, student-centered learning experiences that foster higher-order thinking skills.

The following section discusses selected studies that investigate how the PBL model contributes to the improvement of students' critical thinking ability, illustrating the effectiveness of this approach when supported by digital learning technologies.

Table 1. Research Findings on the Application of the Problem-Based Learning (PBL) Model for Enhancing Critical Thinking Skills and Adversity Quotient

Research(s) and Year	Journal Name	Research Findings
⁷	Wacana Akademika: Majalah Ilmiah Kependidikan	The study revealed that implementing the problem-based learning model via a learning management system (flipped classroom model) was effective in enhancing students' critical thinking skills.
⁸	Jurnal Penelitian Dan Pengembangan Pendidikan	Findings indicated that the use of problem-based learning with a learning management system (specifically using the Quizizz application) enhanced students' critical thinking skills.
⁹	Cetta: Jurnal Ilmu Pendidikan	The research showed that students taught using the PBL model through flipped learning (involving teacher-provided instructional videos) with technology integration demonstrated higher critical thinking skills than those taught using an expository approach.
¹⁰	Cokroaminoto Journal of Primary Education	The findings indicated that the implementation of the PBL model effectively improved students' critical thinking in Indonesian language learning, suggesting its potential as an alternative strategy to enhance such skills.
¹¹	F1000Research	Results revealed that PBL-based learning enhanced students' critical and creative thinking, academic performance, problem-solving abilities, and cooperative learning skills.

⁷ Inayah et al. (2021)

⁸ Indriani et al. (2022)

⁹ Prasetyo et al. (2025)

¹⁰ Wahyuli & Indrawati (2024)

¹¹ Nicholus et al. (2023)

Research(s) and Year	Journal Name	Research Findings
¹²	JPPI (Jurnal Penelitian Pendidikan Indonesia)	This study concluded that blended PBL using Moodle was well-suited for improving students' critical thinking. It connected learning to real-world problems, helping learners practice problem-solving and critical thinking, with Moodle easing knowledge access via technology.
¹³	Jurnal Ilmiah Sekolah Dasar	The findings confirmed that the implementation of PBL through instructional videos enhanced students' critical thinking, indicating that integrating innovative learning models with media has a positive contribution to critical thinking development and student potential.
¹⁴	Jurnal Cendekia: Jurnal Pendidikan Matematika	The study showed that the PBL model significantly improved critical thinking skills with a high effect size (average effect size = 1.47).
¹⁵	Iain Kudus	Results revealed: 1) a significant influence of critical thinking skills on students' mathematics achievement; 2) a significant positive effect of adversity quotient on learning outcomes; and 3) a significant joint influence of both variables on student achievement.
¹⁶	Didaktika: Jurnal Kependidikan	The study found that applying the PBL model and Adversity Quotient had a significant impact on improving students' critical thinking skills.
¹⁷	E3S Web Conf.	The research demonstrated that critical thinking skills improved through learning that employed the PBL model.
¹⁸	JME (Journal of Mathematics Education)	Findings showed that PBL-based instruction enhanced mathematical learning outcomes. Moreover, students with a high Adversity Quotient achieved better academic results.

¹² Zevender et al. (2024)

¹³ Yusuf et al. (2022)

¹⁴ Widodo & Katminingsih (2022)

¹⁵ Ambarwati (2023)

¹⁶ Putri (2024)

¹⁷ Fadjarajani et al. (2024)

¹⁸ Supono & Agoestanto (2023)

Research(s) and Year	Journal Name	Research Findings
¹⁹	Jejak Pembelajaran: Jurnal Pengembangan Pendidikan	Results revealed a significant influence of the PBL model assisted by the Genially application on improving students' critical thinking abilities.
²⁰	Computational Intelligence and Neuroscience	The study showed that the PBL model enhanced students' critical thinking in problem-solving and improved their academic performance.
²¹	Cogent Engineering	Findings indicated that PBL implementation improved students' competencies and academic achievement.

The findings summarized in Table 1 provide an overview of the influence of the Problem-Based Learning (PBL) model integrated with Learning Management Systems (LMS) on students' critical thinking skills and adversity quotient. However, beyond summarizing the results, it is essential to analyze what outcomes emerged, how they occurred, and why these effects appeared across various studies. In general, studies showed that the integration of PBL with LMS platforms (such as Moodle, Google Classroom, and Quizizz) enhanced students' critical thinking skills by promoting problem-oriented activities, collaborative discussions, and reflective inquiry. These processes allow students to engage in deeper reasoning, logical analysis, and evidence-based decision-making skills that are fundamental in mathematics learning.

Furthermore, the use of digital tools within the PBL framework encouraged student autonomy and self-regulation, leading to improved learning persistence and a stronger adversity quotient. Students were more willing to face complex problems because the learning environment supported iterative trials and feedback through LMS-based interaction. The studies also reveal that PBL and LMS synergy affects not only cognitive aspects but also motivational and emotional domains. The LMS structure provides access to resources, asynchronous feedback, and peer communication, which help learners overcome frustration during problem-solving tasks. This in turn fosters resilience and perseverance two key indicators of a strong adversity quotient.

¹⁹ KH & Satianingsih (2024)

²⁰ Li et al. (2022)

²¹ Colmenares-Quintero et al. (2023)

Discussion

In mathematics education specifically, the combination of contextual mathematical problems, group-based inquiry, and interactive LMS features enhances students' engagement and conceptual understanding. This indicates that PBL-LMS integration does not merely improve performance outcomes but transforms the learning process into one that is more student-centered, analytical, and adaptive. Therefore, the SLR findings emphasize that the success of PBL integrated with LMS depends on how teachers design learning tasks, facilitate collaboration, and provide feedback through digital platforms. Merely applying technology is insufficient; its effectiveness relies on the pedagogical alignment between problem-solving stages and LMS functionalities.

The application of the Problem-Based Learning (PBL) model through flipped learning has shown a positive influence on the improvement of students' critical thinking skills ²², The integration of PBL with Learning Management Systems (LMS) has been found to enhance critical thinking abilities ²³, especially when supported by platforms such as Quizizz ²⁴, The use of PBL in combination with PhET simulations also effectively improves students' critical thinking ²⁵, Additionally, problem-based e-learning approaches using LMSs such as Google Classroom and Edmodo promote cooperative and collaborative problem-solving, as well as high-level thinking through multimedia resources. The use of instructional videos within the PBL framework has also been shown to enhance critical thinking ²⁶, and the PBL model is considered effective in fostering critical thinking skills among school students ²⁷. Moreover, it contributes to improvements in creative thinking, academic achievement, and problem-

²² Inayah, Septian, and Komala, "Efektivitas Model Flipped Classroom Berbasis Problem Based Learning Dalam Meningkatkan Kemampuan Berpikir Kritis Mahasiswa."

²³ Syifa Alyadani, Dedi Sofyan, and Epon Nurlaela, "Penerapan Model Pembelajaran Problem Based Learning Berbantuan Media Quizizz Untuk Meningkatkan Kemampuan Berpikir Kritis Siswa Kelas V Sekolah Dasar," *Didaktik: Jurnal Ilmiah PGSD STKIP Subang* 10, no. 1 (2024): 2191–2204, <https://doi.org/https://doi.org/10.36989/didaktik.v10i1.2760>.

²⁴ Indriani, Haryanto, and Gularso, "Dampak Model Pembelajaran Problem Based Learning Berbantuan Media Quizizz Terhadap Kemampuan Berpikir Kritis Mahasiswa."

²⁵ Alda Alvina Hawa, Bambang Supriadi, and Sri Handono Budi Prastowo, "Efektivitas Pengembangan Perangkat Pembelajaran Model PBL Berbantuan Simulasi Phet Pada Materi Termodinamika Untuk Meningkatkan Kemampuan Berpikir Kritis Siswa," *ORBITA: Jurnal Pendidikan Dan Ilmu Fisika* 7, no. 2 (2021): 327–34, <https://doi.org/https://doi.org/10.31764/orbita.v7i2.6041>.

²⁶ Prasetyo, Yurniwati, and Nurjannah, "Pengaruh Model Pembelajaran Flipped Problem Based Learning Terhadap Kemampuan Berpikir Kritis Siswa."

²⁷ Wahyuli and Indrawati, "Pengaruh Penerapan Model Pembelajaran Problem Basic Learning Untuk Meningkatkan Kemampuan Berpikir Kritis Siswa Kelas XII SMA Negeri 7 Makassar Pada Mata Pelajaran Bahasa Indonesia."

solving abilities ²⁸, the integration of digital platforms such as Moodle with blended PBL approaches further supports the development of critical thinking ²⁹, The PBL model also enhances students' potential and critical thinking ³⁰, with studies showing high effect sizes (mean effect size = 1.47) ³¹, Furthermore, PBL has a significant impact on students' learning outcomes, and a positive correlation has been identified between critical thinking, adversity quotient, and academic achievement ³², The combination of PBL and adversity quotient strategies significantly boosts students' critical thinking abilities ³³. PBL also improves adversity quotient, contributing to better learning outcomes the use of applications such as Genially within PBL frameworks enhances critical thinking ^{34,35}, Research also confirms a significant increase in problem-solving and critical thinking skills ^{36,37}, along with substantial improvements in students' competencies and academic performance ^{38,39}.

Based on the data presented, the number of analyzed studies remains limited and could be expanded to strengthen the conclusions. The results section mostly summarizes findings from previous studies but lacks deeper analytical synthesis. There is minimal discussion about *why* certain trends appear (e.g., why PBL supported by LMS improves critical thinking), *what* factors contribute to the variance among studies, and *how* these findings can be implemented in practical educational settings. A more comprehensive interpretive analysis linking causes, mechanisms, and outcomes would enhance the academic rigor and depth of this SLR.

²⁸ Nicholus, Muwonge, and Joseph, "The Role of Problem-Based Learning Approach in Teaching and Learning Physics: A Systematic Literature Review [Version 2; Peer Review: 2 Approved, 2 Approved with Reservations]."

²⁹ Zevender et al., "Learning Model Development Moodle-Based Problem-Based Learning to Improve Critical Thinking Ability."

³⁰ Yusuf, Maulana, and Budiarto, "Implementation of PBL and IBL Models Assisted By Video Media to Improve Critical Thinking Skills."

³¹ Widodo and Katminingsih, "Meta Analisis: Model Pembelajaran PBL Terhadap Kemampuan Berpikir Kritis Matematis Siswa."

³² Ambarwati, "Pengaruh Kemampuan Berpikir Kritis Dan Adversity Quotient Terhadap Hasil Belajar Matematika Siswa MTs Nihayaturroghibin."

³³ (Putri, Fadjarajani et al., 2024)

³⁴ KH and Satianingsih, "Pengaruh Model Pembelajaran Problem Based Learning Berbantu Aplikasi Genially Terhadap Kemampuan Berpikir Kritis."

³⁵ KH and Satianingsih.

³⁶ Li, Deng, and Zhang, "[Retracted] Application of the PBL Model Based on Deep Learning in Physical Education Classroom Integrating Production and Education."

³⁷ Li, Deng, and Zhang.

³⁸ Colmenares-Quintero et al., "Problem Based Learning and Design Thinking Methodologies for Teaching Renewable Energy in Engineering Programs: Implementation in a Colombian University Context."

³⁹ Colmenares-Quintero et al.

Conclusion

This Systematic Literature Review concludes that the integration of Problem-Based Learning (PBL) and Learning Management Systems (LMS) is an effective approach to enhancing students' critical thinking skills and adversity quotient. By combining problem-oriented learning with digital platforms, this approach creates active, collaborative, and reflective learning environments that promote deeper analysis, conceptual understanding, and meaningful knowledge construction. In the context of mathematics education, the PBL–LMS integration is particularly valuable, as it strengthens students' logical reasoning, problem-solving abilities, and adaptability when dealing with complex and contextual problems. Moreover, this integration not only improves cognitive outcomes but also fosters non-cognitive aspects such as resilience, persistence, and motivation, which are essential for successful learning in the 21st century.

However, despite these promising findings, further research is needed to strengthen the empirical foundation of this approach. Future studies should employ experimental or quasi-experimental designs with larger and more diverse samples to validate the effectiveness of PBL–LMS integration across different educational contexts. Additionally, longitudinal research is recommended to examine its long-term impact on both cognitive and affective development. Researchers should also explore the role of instructional design, teacher readiness, and specific LMS features in maximizing learning outcomes, as well as investigate how this integration can be adapted to different subjects and student characteristics for more optimal and inclusive implementation.

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