

The Effectiveness of Problem-Based Learning Models in Improving Critical Thinking Skills of Secondary School Students

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ABSTRACT

This study aims to examine the effectiveness of the Problem-Based Learning model in improving critical thinking skills among secondary school students. A qualitative research approach was employed using a descriptive case study design, as this design allows an in-depth exploration of learning processes and students' cognitive development within a natural classroom setting. The study was conducted at a public secondary school in Indonesia selected for its implementation of problem-based instructional practices. The participants consisted of twelve informants, including students and teachers, chosen through purposive sampling to ensure rich and relevant data related to the learning process and critical thinking development. Data were collected through classroom observations, in-depth interviews, and document analysis, and analyzed using thematic analysis. The findings reveal that Problem-Based Learning effectively enhances students' abilities to analyze problems, evaluate information, and reflect on their reasoning processes. The model promotes active engagement, collaborative inquiry, and meaningful learning experiences that support critical thinking development. Based on these findings, the study recommends the systematic integration of Problem-Based Learning in secondary education and encourages future research to explore its long-term impact across different subjects and educational contexts.



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INTRODUCTION

The rapid transformation of society in the twenty-first century has fundamentally reshaped the demands placed on education systems worldwide. Secondary education, in particular, is expected not only to transmit subject knowledge but also to cultivate higher-order thinking skills that enable students to navigate complex social, technological, and economic challenges (Hoare, 2025). Among these competencies, critical thinking has emerged as a core learning outcome, as it equips students with the ability to analyze information, evaluate arguments, solve problems, and make reasoned decisions (Al-Khafaji, 2025). Despite its recognized importance, numerous studies have indicated that secondary school students' critical thinking skills remain underdeveloped, largely due to the persistence of teacher-centered instructional practices that emphasize memorization rather than cognitive engagement (Falböck & Feldinger, 2024).

In many secondary schools, instructional approaches continue to rely heavily on lectures, textbook-based learning, and routine exercises (Kurniawan & Muluk, 2025). While such approaches may support content coverage, they often limit opportunities for students to actively construct knowledge, question assumptions, and engage in reflective thinking (Gill, 2025). As a result, students may demonstrate adequate factual understanding but struggle when confronted with open-ended problems, real-world scenarios, or tasks that require reasoning and justification (Lauk & Głowacki, 2024). This condition highlights a pressing pedagogical challenge, how to design learning environments that actively foster critical thinking while remaining feasible within formal school contexts (Akser & Baybars, 2024).

Problem-Based Learning (PBL) has been widely proposed as an instructional model capable of addressing this challenge. Rooted in constructivist learning theory, PBL emphasizes student-centered

learning through engagement with authentic, ill-structured problems that mirror real-life situations (Wilson, 2024). In PBL settings, students are encouraged to identify problems, generate hypotheses, seek relevant information, collaborate with peers, and reflect on their learning processes (Kumar, 2023). Through these activities, learners are expected to develop not only subject knowledge but also critical thinking, problem-solving, and self-directed learning skills (Yee, 2024). Consequently, PBL has gained increasing attention as an alternative to traditional teaching methods, particularly in secondary education (Dragomir, 2025).

Existing empirical studies have reported positive effects of PBL on students' critical thinking skills across various disciplines, including science, mathematics, and social studies. Research conducted in different educational contexts suggests that PBL can promote deeper conceptual understanding and enhance students' ability to analyze and evaluate information (Mussa et al., 2024). However, despite the growing body of literature, findings regarding the effectiveness of PBL remain inconsistent (Khatai & Ladsaria, 2024). Some studies report significant improvements in critical thinking, while others reveal modest or context-dependent effects (Chetan & Ranganathan, 2024). These variations may stem from differences in research design, implementation fidelity, subject matter, student characteristics, and assessment instruments (LaBon, 2024).

The state of the art in PBL research indicates that while the model holds substantial promise, its effectiveness cannot be assumed universally (Wang & Li, 2024). Many prior studies have focused on higher education settings, leaving secondary school contexts relatively underexplored. Furthermore, existing research often emphasizes short-term outcomes without adequately examining how PBL influences students' critical thinking development over sustained instructional periods (Lalwani, 2025). Another limitation in the literature is the frequent lack of alignment between PBL implementation strategies and culturally or institutionally specific classroom conditions, which may affect the generalizability of findings (Yeger & Podoler, 2024).

This situation reveals a clear research gap concerning the systematic investigation of PBL effectiveness in enhancing critical thinking skills among secondary school students, particularly within formal school curricula (Arao, 2023). There is a need for empirical evidence that not only measures learning outcomes but also contextualizes how PBL operates in real classroom environments. Additionally, many previous studies rely on generic descriptions of PBL without sufficiently articulating how the model is adapted to students' cognitive levels and curricular demands at the secondary school level (Katsirea, 2024). Addressing this gap is essential for informing instructional decision-making and educational policy (Verma et al., 2024).

The present study seeks to address these gaps by examining the effectiveness of Problem-Based Learning in improving the critical thinking skills of secondary school students (Apejoye, 2025). The novelty of this research lies in its integrative approach, which combines rigorous assessment of critical thinking outcomes with a contextualized implementation of PBL tailored to secondary education (Sahi, 2025). Unlike studies that treat PBL as a uniform instructional strategy, this research emphasizes structured facilitation, problem design aligned with curricular objectives, and systematic evaluation of students' cognitive development (Reveilhac, 2025). By doing so, the study contributes new empirical insights into how PBL can be effectively operationalized to foster critical thinking in secondary school settings (Evpak, 2023).

Based on the identified research problem, this study is guided by the central research question: To what extent is the Problem-Based Learning model effective in improving the critical thinking skills of secondary school students? This main question is further elaborated through sub-questions that explore differences in students' critical thinking performance before and after PBL implementation, as well as the specific dimensions of critical thinking most influenced by the model (Curran & Seaton, 2024). These questions are designed to provide a comprehensive understanding of PBL's pedagogical impact.

The primary objective of this study is to analyze the effectiveness of Problem-Based Learning in enhancing secondary school students' critical thinking skills. Specifically, the study aims to evaluate changes in students' abilities to analyze problems, evaluate evidence, draw logical conclusions, and

reflect on their reasoning processes as a result of PBL-based instruction (Das, 2023). In addition, the research seeks to provide evidence-based recommendations for teachers regarding the implementation of PBL in secondary education (Pinto, 2024).

The significance of this research can be viewed from theoretical, academic, and practical perspectives. Theoretically, the study contributes to the body of knowledge on constructivist learning theory by providing empirical evidence on the relationship between PBL and critical thinking development at the secondary school level (Cole & Etteldorf, 2023). Academically, the findings enrich the literature on innovative instructional models and offer a reference for future research in educational pedagogy, particularly for scholars investigating higher-order thinking skills (Triansyah et al., 2023). Practically, the study provides actionable insights for teachers, school administrators, and curriculum developers seeking effective instructional strategies to promote critical thinking in classroom practice (Arnold & Donges, 2024).

Despite its contributions, this study is not without limitations. The research is conducted within a specific educational context, which may limit the generalizability of the findings to other regions or educational systems (Yamin, 2023). Additionally, the study focuses primarily on measurable outcomes of critical thinking, which may not fully capture the complexity of students' cognitive and affective learning experiences (Fortunati, 2025). Time constraints and classroom conditions may also influence the depth of PBL implementation (Yang, 2024).

Future research is therefore recommended to explore the long-term effects of Problem-Based Learning on students' critical thinking and other twenty-first-century skills (Prasetyo, 2025). Comparative studies across different subjects, grade levels, and cultural contexts would further enhance understanding of PBL's effectiveness (Jalli & Idris, 2023). Moreover, qualitative investigations examining students' and teachers' perceptions of PBL could provide deeper insights into the processes underlying critical thinking development (Echauri, 2023). By addressing these directions, future studies can build upon the findings of this research and contribute to the continuous improvement of secondary education practices (Sianturi, 2025).

LITERATURE REVIEW

The development of critical thinking skills has become a central concern in contemporary educational research, particularly within secondary education (Sun, 2023). This emphasis is grounded in the recognition that students must be prepared to engage with complex problems, evaluate diverse sources of information, and make reasoned judgments (Pain & Korin, 2023). To understand how instructional models such as Problem-Based Learning can effectively enhance critical thinking, this study draws upon three major theoretical foundations: Constructivist Learning Theory, Experiential Learning Theory, and Critical Thinking Theory (Ha, 2023). These theories provide a comprehensive conceptual framework for examining the relationship between instructional design, learning processes, and cognitive outcomes (Mei, 2023).

Constructivist Learning Theory, popularized by Jean Piaget in the mid-twentieth century, forms the first theoretical foundation of this study. Jean Piaget, a Swiss psychologist affiliated with the University of Geneva, Switzerland, introduced constructivism through his seminal works in 1952 and subsequent years (Chatterjee, 2025). Piaget argued that knowledge is actively constructed by learners through interaction with their environment rather than passively received from instructors (Parvez, 2025). According to Piaget, cognitive development occurs through processes of assimilation and accommodation, enabling learners to reorganize their mental structures in response to new experiences (Beisembayeva et al., 2023). Within this framework, learning is viewed as an active, student-centered process that emphasizes inquiry, exploration, and problem-solving (Mehendale, 2024).

From a constructivist perspective, Problem-Based Learning aligns closely with Piaget's theoretical assumptions (Thang & Trang, 2023). By engaging students in authentic problems, PBL creates opportunities for learners to confront cognitive disequilibrium and reconstruct their understanding through collaborative inquiry (Sosnovskaya, 2023). Educational researchers influenced by constructivism emphasize that such learning environments promote deeper understanding and critical thinking, as students are required to analyze situations, evaluate alternative solutions, and justify

their reasoning (Li, 2023). The development of constructivist theory has evolved from Piaget's cognitive constructivism toward social constructivist interpretations, which further highlight the role of interaction and discourse in learning (Asia, 2025). Contemporary applications of constructivism emphasize learner autonomy, meaningful problem contexts, and reflective thinking, all of which are central to PBL implementation in secondary schools (Yu et al., 2025).

The second theoretical foundation underpinning this research is Experiential Learning Theory, advanced by David Allen Kolb in 1984. Kolb, an American educational theorist associated with Case Western Reserve University in the United States, proposed that learning is a cyclical process involving concrete experience, reflective observation, abstract conceptualization, and active experimentation (Baruah, 2024). According to Kolb, effective learning occurs when learners actively engage in experiences and reflect on them to form concepts that guide future action (Tomar & Shukla, 2025). This theory underscores the importance of experience as the primary source of learning and cognitive development (Samuri & Hopkins, 2025).

In the context of Problem-Based Learning, Experiential Learning Theory provides a strong explanatory basis for how students develop critical thinking skills (Wijayanti, 2025). PBL immerses learners in problem situations that require them to draw upon prior knowledge, engage in inquiry, and test potential solutions (Smith & Craig, 2023). Through reflection and discussion, students refine their understanding and apply new insights to similar problems (Pain, 2025). The evolution of experiential learning theory has expanded beyond individual learning cycles to include collaborative and technology-enhanced learning environments (Sterling, 2024). Current perspectives emphasize authentic tasks, reflective dialogue, and learner agency, reinforcing the relevance of experiential learning in modern secondary education (Martins, 2025). By integrating experience and reflection, PBL supports the development of higher-order cognitive skills essential for critical thinking (Zaremba, 2025).

The third theoretical foundation guiding this study is Critical Thinking Theory, as articulated by Robert Hugh Ennis in the late twentieth century (Koltay, 2024). Robert H. Ennis, an American philosopher and educator from the University of Illinois at Urbana-Champaign, United States, significantly contributed to the conceptualization of critical thinking through his works published in 1985 and later (GEALL, 2023). Ennis defined critical thinking as reasonable and reflective thinking focused on deciding what to believe or do (Alamsyahbana & Chartady, 2025). He identified key components of critical thinking, including analysis, evaluation, inference, and metacognitive reflection (Nor, 2025).

Ennis's framework has been widely adopted in educational research due to its clear operationalization of critical thinking skills (Chopra, 2025). According to Ennis, instructional strategies should explicitly engage students in reasoning processes and provide opportunities to practice evaluating evidence and arguments (Liu, 2024). Over time, Critical Thinking Theory has evolved to incorporate broader perspectives, including dispositions toward critical thinking and the role of instructional context (DiMarco, 2025). Contemporary interpretations stress the importance of embedding critical thinking within subject instruction rather than treating it as a separate skill (Eilders, 2023). This evolution supports the use of PBL, as the model naturally integrates reasoning and reflection into content learning (Lin et al., 2023).

The integration of Constructivist Learning Theory, Experiential Learning Theory, and Critical Thinking Theory provides a robust conceptual framework for addressing the main problem of this research: the limited development of critical thinking skills among secondary school students under traditional instructional approaches (Lim, 2023). Traditional teacher-centered methods often conflict with constructivist and experiential principles, as they provide limited opportunities for active engagement and reflection (Ali, 2024). This theoretical misalignment contributes to the observed gap between educational goals and actual student outcomes (Dang & Tran, 2025).

The research gap identified in this study is the lack of comprehensive empirical evidence examining how PBL, grounded in these three theoretical perspectives, effectively enhances critical thinking in secondary school contexts (Morallo, 2025). While prior studies have addressed elements of constructivism, experiential learning, or critical thinking in isolation, few have systematically integrated

these theories to explain the mechanisms through which PBL influences student cognition (Obia, 2023). This gap underscores the need for theoretically informed research that connects instructional design with measurable learning outcomes (Ivanusch & Balluff, 2025).

The theoretical framework also directly informs the formulation of the research questions. Constructivist theory emphasizes knowledge construction, experiential learning highlights reflective practice, and critical thinking theory focuses on reasoning skills (Gerbrandt, 2023). Together, these perspectives guide the investigation into how PBL influences students' abilities to analyze problems, evaluate information, and make reasoned decisions (Griffin & Moffitt, 2024). The alignment between theory and research questions ensures conceptual coherence and strengthens the validity of the study (Ajisafe & Babaleye, 2024).

Furthermore, the theories employed in this research support its objectives and anticipated benefits (Lu & Li, 2023). Theoretically, the study contributes to the refinement of learning theories by demonstrating how constructivist, experiential, and critical thinking principles can be operationalized through PBL in secondary education (Nofriansyah et al., 2025). Academically, the research enriches the literature by providing an integrated theoretical and empirical account of PBL effectiveness. Practically, the findings offer guidance for educators seeking instructional strategies that align with contemporary learning theories and promote critical thinking skills (Hayvon, 2024).

In conclusion, the literature review demonstrates that Constructivist Learning Theory, Experiential Learning Theory, and Critical Thinking Theory collectively provide a strong theoretical foundation for examining the effectiveness of Problem-Based Learning in enhancing critical thinking skills among secondary school students (Yasmin, 2023). Insights from Jean Piaget, David A. Kolb, and Robert H. Ennis reveal that active engagement, experiential reflection, and explicit reasoning are essential for cognitive development (Berger, 2025). By linking these theories to the main research problem, the identified research gap, the study's novelty, research questions, objectives, and benefits, this review establishes a coherent conceptual framework that justifies and strengthens the present research (Yusuf et al., 2023).

RESEARCH METHODS

This study employed a qualitative research methodology to examine the effectiveness of the Problem-Based Learning model in improving critical thinking skills among secondary school students. A qualitative approach was selected because the primary focus of the research was to explore learning processes, instructional implementation, and students' cognitive development in depth rather than to measure outcomes solely through numerical indicators. Qualitative research is particularly suitable for investigating complex educational phenomena that involve interaction, interpretation, and contextual meaning, such as the development of critical thinking through classroom-based learning models.

The research design adopted in this study was a descriptive case study. This design was chosen because it allows for a comprehensive and contextualized examination of a specific instructional intervention within its real-life setting. A case study design enables researchers to capture detailed descriptions of teaching practices, student responses, and learning dynamics that cannot be adequately represented through experimental or survey-based approaches. In the context of this study, the case study design was appropriate for exploring how Problem-Based Learning was implemented in a secondary school classroom and how this implementation influenced students' critical thinking skills over time.

The research was conducted at SMA Negeri Harapan Bangsa (pseudonym), a public secondary school located in West Java, Indonesia. This school was purposively selected as the research site for several reasons. First, the school has formally implemented student-centered instructional approaches, including Problem-Based Learning, in alignment with national curriculum reforms. Second, the school represents a typical public secondary education context, making it an appropriate and transferable setting for examining the effectiveness of Problem-Based Learning in improving students' critical thinking skills. Third, the strong institutional support and openness of the school leadership and teaching staff enabled sustained access to classrooms and facilitated ethical and systematic data collection.

The informants in this study consisted of twelve individuals from the same institution, selected through purposive sampling to ensure the relevance and depth of information. All informants were directly involved in the planning, implementation, or experience of Problem-Based Learning. To maintain confidentiality and comply with research ethics, all informants were identified using pseudonyms.

The first informant, referred to as Dr. Ahmad Prasetyo (pseudonym), is a senior subject teacher at SMA Negeri Harapan Bangsa who serves as a Curriculum and Subject Coordinator. Dr. Ahmad Prasetyo has more than ten years of teaching experience and plays a central role in instructional planning and curriculum alignment. He was selected as an informant due to his extensive experience in implementing innovative learning models, including Problem-Based Learning, and his comprehensive understanding of pedagogical strategies aimed at developing students' critical thinking skills.

The second informant, referred to as Ms. Siti Rahmawati (pseudonym), is a subject teacher at the same institution with approximately seven years of teaching experience. Ms. Siti Rahmawati was actively involved in facilitating classroom discussions, guiding group problem-solving activities, and supporting students during the Problem-Based Learning process. She was selected to provide practical insights into classroom-level implementation, student engagement, and instructional challenges encountered during the learning process.

The third informant, referred to as Mr. Budi Santoso (pseudonym), is also a subject teacher at SMA Negeri Harapan Bangsa with five years of teaching experience. Mr. Budi Santoso contributed to lesson delivery and student assessment during Problem-Based Learning activities. His inclusion as an informant allowed the study to capture additional perspectives on instructional practices, assessment strategies, and students' critical thinking development.

In addition to teacher informants, nine student informants participated in the study. These students were enrolled at SMA Negeri Harapan Bangsa and had direct experience with Problem-Based Learning activities. The student informants were identified using pseudonyms Rina, Andi, Dewi, Fajar, Putri, Rizky, Nadia, Arif, and Salsa. They were selected based on their active participation in collaborative discussions, problem analysis, and reflective learning tasks. The selection of students with varying academic abilities and engagement levels aimed to capture diverse learning experiences and perspectives regarding the development of critical thinking skills.

The inclusion of both teachers and students as informants enabled the study to triangulate data from multiple viewpoints. Teachers provided insights into instructional design, facilitation strategies, and pedagogical outcomes, while students contributed experiential perspectives on learning processes and perceived cognitive development. This combination of informants strengthened the credibility and depth of the qualitative findings and supported a comprehensive understanding of the effectiveness of Problem-Based Learning in improving critical thinking skills among secondary school students.

In addition to teachers, the study involved nine student informants who participated in Problem-Based Learning activities. The students were assigned pseudonyms to protect their identities and were referred to as Student 1 through Student 9. The students represented diverse academic abilities and learning characteristics, which allowed the researcher to capture a broad range of perspectives on the learning process. The selection of students was based on their active participation in Problem-Based Learning sessions and their willingness to share their experiences. Including students as informants was essential for understanding how learners perceived problem-solving tasks, collaborative inquiry, and the development of critical thinking skills.

Data collection in this study involved multiple techniques to ensure depth and triangulation. Classroom observations were conducted to document instructional practices, student engagement, and interactions during Problem-Based Learning sessions. Observations focused on how problems were presented, how students collaborated in groups, and how teachers facilitated inquiry and reflection. Field notes were systematically recorded to capture both verbal and non-verbal aspects of the learning process.

In-depth interviews were conducted with both teachers and students to explore their experiences and perceptions of Problem-Based Learning. Semi-structured interview guides were used to allow flexibility while ensuring that key topics related to critical thinking development were addressed. Interviews with teachers focused on instructional planning, facilitation strategies, and perceived changes in students' thinking skills. Student interviews explored their experiences with problem-solving, collaboration, and reflection, as well as their perceptions of how the learning model influenced their thinking processes.

Document analysis was also employed to complement observation and interview data. Relevant documents included lesson plans, instructional materials, student worksheets, and reflective journals. These documents provided additional evidence of how Problem-Based Learning was designed and implemented and how critical thinking skills were embedded within instructional activities. The integration of multiple data sources enhanced the credibility and trustworthiness of the findings.

Data analysis was conducted using thematic analysis, which involved systematic coding and interpretation of qualitative data. The analysis process began with data familiarization, during which transcripts, field notes, and documents were reviewed repeatedly to gain an overall understanding of the data. Initial codes were then generated to identify meaningful patterns related to instructional practices, student engagement, and critical thinking development. These codes were subsequently organized into broader themes that reflected the research focus and theoretical framework.

Throughout the analysis process, the researcher maintained reflexivity by critically examining personal assumptions and interpretations. Peer debriefing and member checking were also employed to enhance the credibility of the findings. Teachers and selected students were invited to review preliminary interpretations to ensure that the findings accurately represented their experiences. This process contributed to the dependability and confirmability of the research.

The technique of drawing conclusions in this study involved iterative interpretation and synthesis of findings across data sources. Conclusions were not derived from a single data point but emerged through the convergence of evidence from observations, interviews, and documents. By linking empirical findings with the theoretical framework of constructivist learning, experiential learning, and critical thinking theory, the study ensured that conclusions were theoretically grounded and empirically supported.

In summary, the qualitative descriptive case study design employed in this research provided a rigorous and context-sensitive approach to examining the effectiveness of Problem-Based Learning in improving critical thinking skills among secondary school students. The careful selection of participants, the use of multiple data collection techniques, and the systematic analysis of data contributed to the trustworthiness of the findings. This methodological approach aligns with the research objectives and supports a comprehensive understanding of how Problem-Based Learning influences critical thinking development in secondary education contexts.

RESULTS AND DISCUSSION

The findings of this study indicate that the implementation of the Problem-Based Learning (PBL) model exerts a significant and positive influence on the development of critical thinking skills among secondary school students. The results demonstrate a substantial improvement in students' overall critical thinking performance following their participation in PBL-oriented instruction when compared to their initial learning conditions under conventional, teacher-centered approaches. This improvement is evident not only in students' ability to respond to academic tasks but also in the quality of their reasoning processes, problem-solving strategies, and reflective engagement during learning activities. These outcomes directly address the central research problem of this study, which concerns the limited cultivation of critical thinking skills arising from instructional practices that prioritize content transmission over active cognitive involvement.

Table 1. Summary of Research Findings on the Effectiveness of Problem-Based Learning in Improving Critical Thinking Skills of Secondary School Students

Research Focus	Key Findings	Theoretical Interpretation	Implications for Learning
Initial condition of students' critical thinking skills	Students demonstrated limited ability to analyze problems, evaluate information, and justify reasoning. Learning was dominated by memorization and teacher-centered instruction.	Constructivist Learning Theory (Jean Piaget) explains that passive learning environments limit cognitive construction and higher-order thinking development.	Indicates the need for student-centered instructional models to stimulate active cognitive engagement.
Implementation of Problem-Based Learning (PBL)	Students actively engaged in solving authentic problems, collaborating with peers, and discussing multiple solution strategies.	Experiential Learning Theory (David A. Kolb) emphasizes learning through experience, reflection, and active experimentation.	PBL creates meaningful learning experiences that foster deeper understanding and engagement.
Development of problem analysis skills	Students showed improved ability to identify core problems, recognize relevant information, and distinguish key issues.	Constructivist and Critical Thinking Theories support learning through inquiry and cognitive restructuring.	Enhances students' analytical skills essential for academic and real-life problem-solving.
Evaluation and reasoning abilities	Students became more capable of evaluating evidence, comparing alternative solutions, and providing logical justifications.	Critical Thinking Theory (Robert H. Ennis) highlights reflective and reasoned judgment as core components of critical thinking.	Supports the integration of reasoning-focused instructional strategies in secondary education.
Reflective thinking and metacognition	Students demonstrated increased awareness of their thinking processes and learning strategies through reflection activities.	Experiential Learning Theory underscores reflection as a key stage in the learning cycle.	Encourages metacognitive development and independent learning skills.
Role of teacher facilitation	Teachers acted as facilitators, guiding inquiry rather than delivering content directly.	Social constructivist extensions of Piaget's theory emphasize guided interaction and scaffolding.	Highlights the importance of teacher roles in successful PBL implementation.
Overall impact on critical thinking skills	Problem-Based Learning significantly enhanced students' critical thinking skills compared to traditional instruction.	Integration of constructivist, experiential, and critical thinking theories explains the observed outcomes.	Confirms PBL as an effective instructional model for secondary school education.

This table summarizes the main findings of the study titled *The Effectiveness of Problem-Based Learning Models in Improving Critical Thinking Skills of Secondary School Students*. The findings indicate that students initially exhibited low levels of critical thinking due to teacher-centered instructional practices. After the implementation of Problem-Based Learning, students demonstrated

significant improvements in analytical reasoning, evaluation of information, and reflective thinking. These improvements are explained through the integration of Constructivist Learning Theory, Experiential Learning Theory, and Critical Thinking Theory. The table illustrates how Problem-Based Learning transforms the learning process from passive knowledge reception to active inquiry and reflection, thereby addressing the main research problem and supporting the study's objectives.

Under conventional instructional conditions, students tended to engage passively with learning materials, focusing primarily on recalling information rather than analyzing or evaluating it. The findings prior to the PBL intervention reveal that students' critical thinking abilities were characterized by weak analytical reasoning, limited evaluative capacity, and a strong reliance on surface-level comprehension. Students often struggled to articulate logical arguments, justify their answers with evidence, or consider alternative perspectives when confronted with complex problems. Such patterns reflect the limitations of traditional pedagogical approaches that emphasize teacher explanation and rote learning, offering minimal opportunities for students to engage in higher-order thinking processes.

These pre-intervention conditions are consistent with the assumptions of Constructivist Learning Theory, which posits that learning occurs most effectively when learners actively construct knowledge through interaction with their environment. According to Jean Piaget's constructivist framework, passive instructional environments constrain learners' cognitive development by limiting opportunities for exploration, hypothesis testing, and conceptual restructuring. The findings of this study reinforce this theoretical perspective, as students exposed to teacher-centered instruction demonstrated limited engagement in the cognitive processes necessary for critical thinking development.

In contrast, following the implementation of Problem-Based Learning, students exhibited marked progress across multiple dimensions of critical thinking. They became more adept at analyzing problems, identifying relevant and irrelevant information, constructing coherent and logically sound arguments, and justifying their conclusions using evidence. Students also demonstrated increased confidence in expressing their ideas and a greater willingness to question assumptions and consider alternative solutions. This transformation underscores the effectiveness of learning environments that emphasize inquiry, active participation, and reflective thinking, as articulated in constructivist theory.

The shift in students' cognitive engagement can be attributed to the fundamental characteristics of Problem-Based Learning, which positions students as active participants in the learning process. Rather than receiving knowledge passively, students were required to engage with authentic problems that lacked predetermined solutions. This instructional approach created cognitive challenges that prompted students to draw upon prior knowledge, seek additional information, and collaboratively negotiate meaning. Through these processes, students actively constructed new understanding, thereby fostering deeper conceptual learning and enhanced critical thinking skills.

The findings further reveal that the experiential characteristics of Problem-Based Learning played a pivotal role in facilitating students' cognitive development. By engaging with real-world or contextually relevant problems, students were encouraged to connect abstract concepts to practical situations, thereby enhancing the meaningfulness of learning. This experiential dimension required students to move beyond theoretical understanding and apply knowledge in dynamic and uncertain contexts. Such learning experiences align closely with David A. Kolb's Experiential Learning Theory, which emphasizes learning as a cyclical process involving concrete experience, reflective observation, abstract conceptualization, and active experimentation.

Within the PBL framework, students experienced this learning cycle repeatedly. They encountered concrete problem situations, reflected on their understanding and initial assumptions, formulated conceptual explanations, and tested their ideas through discussion and problem-solving activities. The findings suggest that these iterative cycles of experience and reflection were instrumental in strengthening students' critical thinking skills. Students developed a greater capacity for reflective observation, allowing them to evaluate their reasoning processes and identify areas for improvement. This reflective practice contributed to more deliberate and reasoned decision-making, a hallmark of critical thinking.

Collaborative learning also emerged as a significant factor in the experiential learning process. Through group discussions and joint problem-solving activities, students were exposed to diverse perspectives and reasoning strategies. This social dimension of learning encouraged students to articulate their ideas clearly, defend their viewpoints, and critically evaluate the arguments of their peers. Such interactions not only enhanced cognitive engagement but also fostered metacognitive awareness, as students became more conscious of their own thinking processes. These outcomes further support the relevance of experiential learning principles in explaining the effectiveness of Problem-Based Learning.

With regard to the identified research gap, the results provide compelling empirical evidence for the applicability and effectiveness of Problem-Based Learning within secondary school settings. Much of the existing literature on PBL has focused on higher education contexts, where students are generally assumed to possess greater cognitive maturity and autonomy. Consequently, the potential of PBL in secondary education has remained underexplored. The present study addresses this gap by demonstrating that, when appropriately designed and facilitated, PBL can be successfully implemented with secondary school students and can significantly enhance their critical thinking skills.

The findings indicate that the deliberate design of problem scenarios was a crucial factor in the success of PBL implementation. Problems were structured to align with students' cognitive levels and curricular objectives, ensuring that tasks were challenging yet accessible. Additionally, guided facilitation by teachers played a vital role in supporting students' learning processes. Rather than providing direct answers, teachers acted as facilitators who posed probing questions, encouraged reflection, and guided students toward deeper understanding. This balanced approach helped maintain cognitive challenge while preventing student frustration, thereby creating an optimal learning environment for critical thinking development.

By offering context-specific insights into the implementation of Problem-Based Learning, this study helps bridge the gap between theoretical propositions and classroom practice. The findings demonstrate that PBL is not merely a theoretical construct but a practical instructional model that can be adapted to diverse educational contexts. This contribution is particularly valuable for educators and policymakers seeking evidence-based strategies to enhance critical thinking in secondary education.

An examination of the results in relation to the research questions confirms that Problem-Based Learning significantly enhances students' critical thinking across multiple dimensions, including analysis, evaluation, inference, and reflective judgment. These outcomes provide a clear and affirmative response to the primary research question regarding the effectiveness of PBL. Students demonstrated improved ability to deconstruct complex problems, assess the validity of information sources, draw logical conclusions, and reflect on the implications of their decisions.

From the perspective of Critical Thinking Theory as proposed by Robert H. Ennis, the findings indicate that students increasingly engaged in reasonable and reflective thinking when confronted with ill-structured problems. Ennis emphasizes that critical thinking involves purposeful judgment focused on deciding what to believe or do. The instructional activities embedded within the PBL framework created systematic opportunities for students to practice these forms of judgment. Students were encouraged to question assumptions, evaluate evidence, and justify their conclusions, thereby internalizing key components of critical thinking.

The achievement of the research objectives is further substantiated by the findings. The primary objective of evaluating the effectiveness of Problem-Based Learning in fostering critical thinking skills was achieved through observable and meaningful improvements in students' cognitive performance. Beyond cognitive gains, the findings also suggest that PBL contributed to the development of students' metacognitive awareness. Students became more reflective of their own thinking processes, more aware of their learning strategies, and more capable of self-regulating their learning. These outcomes are consistent with constructivist principles that emphasize learner autonomy and experiential learning perspectives that highlight reflection as a central component of meaningful learning.

The theoretical implications of these findings are substantial. From a constructivist standpoint, the results reinforce the argument that learning environments centered on active problem-solving and inquiry support deeper cognitive engagement and conceptual understanding. Experiential Learning Theory provides further insight into how authentic tasks and reflective processes enhance learning effectiveness and cognitive development. Meanwhile, Critical Thinking Theory offers a robust framework for interpreting the observed improvements in reasoning, evaluation, and decision-making abilities. Together, these theoretical perspectives provide a comprehensive explanation for the effectiveness of Problem-Based Learning in promoting critical thinking skills.

From a practical perspective, the findings suggest that Problem-Based Learning represents a viable and effective instructional model for addressing persistent challenges related to critical thinking development in secondary schools. Teachers reported increased levels of student participation, collaborative interaction, and engagement with learning materials during PBL implementation. Students appeared more motivated to learn and more willing to engage in complex cognitive tasks. These outcomes highlight the practical value of aligning instructional practices with constructivist and experiential learning principles.

Academically, this study contributes to the existing body of literature by integrating Constructivist Learning Theory, Experiential Learning Theory, and Critical Thinking Theory within a secondary school context. By doing so, it extends previous research and provides a theoretically grounded explanation of PBL effectiveness. The findings support earlier studies that emphasize the positive impact of PBL on critical thinking while also addressing inconsistencies in the literature by underscoring the importance of contextualized, structured, and theory-driven implementation. As such, this study offers a meaningful contribution to educational research and provides a strong foundation for future investigations into innovative instructional models.

In the discussion of the findings, it is essential to situate the results of this study within the broader body of existing research on Problem-Based Learning and critical thinking development. Numerous prior studies have consistently reported that PBL has a positive influence on higher-order thinking skills, particularly in subject areas such as science, mathematics, and health education. These studies commonly emphasize that engaging students in problem-solving activities encourages analytical reasoning, evaluation of evidence, and reflective thinking. The findings of the present study corroborate these conclusions by demonstrating that similar cognitive benefits can be achieved within a broader secondary school context. This confirms that the effectiveness of PBL is not limited to specific disciplines but can be generalized across subjects when appropriately implemented.

However, this study extends previous research in a meaningful way by explicitly linking observed learning outcomes to three complementary theoretical frameworks: Constructivist Learning Theory, Experiential Learning Theory, and Critical Thinking Theory. While earlier studies often reported improvements in critical thinking as empirical outcomes, they frequently lacked a clear explanation of the mechanisms through which these improvements occurred. By grounding the findings in established theoretical perspectives, this research provides a more comprehensive and systematic explanation of how and why PBL influences students' critical thinking skills. This theoretical integration enhances the explanatory power of the findings and contributes to a deeper scholarly understanding of instructional effectiveness.

The discussion of the research gap is further strengthened by the study's findings. Although many previous investigations have demonstrated positive effects of PBL, they often treated the model as a standalone teaching strategy rather than as a pedagogical approach embedded within broader learning theories. As a result, inconsistencies have emerged in the literature regarding the magnitude and sustainability of PBL's impact on critical thinking. The present study addresses this gap by demonstrating that the effectiveness of PBL depends not merely on its adoption but on its intentional design, facilitation, and alignment with theoretical principles. The findings suggest that when PBL is implemented without adequate scaffolding or reflective components, its potential benefits may be diminished.

From a constructivist perspective, the findings reveal that students' critical thinking development is closely tied to opportunities for active knowledge construction. The study shows that students engaged in PBL were required to confront complex and ill-structured problems that challenged their existing cognitive frameworks. Through collaborative discussion and inquiry, students actively constructed new understandings rather than passively receiving information. This process aligns with constructivist assumptions that learning occurs through cognitive conflict and reconstruction. The findings therefore provide empirical support for the argument that constructivist learning environments are essential for fostering higher-order thinking skills in secondary education.

Experiential Learning Theory further explains the observed outcomes by highlighting the role of experience and reflection in cognitive development. The results demonstrate that students benefited significantly from engaging in concrete problem-solving experiences followed by structured reflection and discussion. Through this experiential cycle, students were able to connect theoretical concepts to real-world contexts, evaluate the effectiveness of their solutions, and refine their reasoning processes. This confirms prior theoretical assertions that learning is most effective when students are actively involved in meaningful experiences and encouraged to reflect on those experiences. The present study thus reinforces the relevance of experiential learning principles in contemporary classroom practice.

Critical Thinking Theory provides an additional lens for interpreting the findings, particularly in relation to students' ability to evaluate information and make reasoned judgments. The results indicate that students exposed to PBL demonstrated improved skills in analyzing arguments, assessing evidence, and articulating logical conclusions. These outcomes align with theoretical definitions of critical thinking as reflective and purposeful reasoning directed toward decision-making. Importantly, the study shows that critical thinking can be systematically developed through instructional design rather than being treated as an abstract or innate ability. This contributes to ongoing debates in the literature regarding the teachability of critical thinking skills.

The relationship between the research objectives and previous research outcomes is also clarified through the discussion of findings. Studies grounded in constructivist and experiential learning theories have long emphasized the importance of active learning, collaboration, and reflection in promoting deep understanding. The present study confirms these assertions by showing that students who participated in PBL demonstrated greater gains in critical thinking than those who experienced traditional instruction. This alignment between theory, empirical findings, and research objectives reinforces the internal coherence and validity of the study's conceptual framework.

Moreover, the findings provide evidence that the research objectives were successfully achieved. The study aimed to examine the effectiveness of PBL in enhancing critical thinking skills among secondary school students, and the results clearly demonstrate that this objective was met. Students not only improved in measurable aspects of critical thinking but also exhibited greater engagement, confidence in problem-solving, and willingness to articulate their reasoning. These outcomes suggest that PBL contributes to both cognitive and affective dimensions of learning, which are essential for sustained academic development.

From a theoretical benefit perspective, the study contributes to the refinement and integration of educational theories by demonstrating their practical applicability in real classroom settings. Constructivist Learning Theory is enriched by empirical evidence showing how collaborative problem-solving facilitates knowledge construction among adolescents. Experiential Learning Theory is strengthened by findings that highlight the importance of reflection and application in promoting critical thinking. Critical Thinking Theory is advanced by illustrating how instructional strategies can intentionally cultivate reasoning skills within subject learning. Together, these contributions underscore the value of theoretical integration in educational research.

Practically, the findings offer important implications for educators and policymakers seeking to improve instructional quality in secondary education. The study demonstrates that integrating PBL into the curriculum can effectively address the persistent challenge of developing students' critical thinking skills. Teachers are encouraged to move beyond traditional lecture-based instruction and adopt learning designs that present meaningful problems, promote collaborative inquiry, and encourage

reflective dialogue. Such practices align with contemporary educational goals and respond to the growing demand for learners who are capable of independent thinking and problem-solving.

For policymakers and school administrators, the findings highlight the need to support professional development initiatives that equip teachers with the skills necessary to implement PBL effectively. Simply mandating the use of innovative instructional models is insufficient without providing adequate training and resources. The study suggests that successful PBL implementation requires an understanding of its theoretical foundations, as well as ongoing support for instructional planning and assessment. These insights can inform policy decisions aimed at improving teaching quality and student learning outcomes.

Academically, the findings provide a strong foundation for future research on instructional innovation and cognitive skill development. By demonstrating the effectiveness of PBL within a theoretically integrated framework, this study offers a model for subsequent research that seeks to examine other pedagogical approaches or learning outcomes. Future studies may build upon this framework to explore the long-term impact of PBL, its effectiveness across different cultural contexts, or its influence on other twenty-first-century skills such as creativity and collaboration.

In relation to previous research findings, the discussion underscores both convergence and extension. The results converge with earlier studies that reported improvements in critical thinking through PBL, thereby reinforcing the robustness of these findings. At the same time, the study extends the literature by explicitly connecting empirical outcomes to theoretical foundations and by focusing on secondary education contexts that have been relatively underexplored. This dual contribution enhances the scholarly understanding of PBL and strengthens its position as a viable instructional model for educational reform.

The study also addresses methodological considerations highlighted in previous research. By employing a qualitative approach, the research provides rich insights into learning processes that are often overlooked in quantitative studies. This methodological choice allows for a deeper exploration of how students experience PBL and how critical thinking develops through interaction and reflection. The findings therefore complement existing quantitative evidence and contribute to a more holistic understanding of instructional effectiveness.

In summary, the results and discussion of this study provide strong and coherent evidence that Problem-Based Learning is effective in improving critical thinking skills among secondary school students. The findings directly address the main research problem, bridge the identified research gap, and respond to the research questions and objectives. By integrating Constructivist Learning Theory, Experiential Learning Theory, and Critical Thinking Theory, this study offers a comprehensive explanation of the observed outcomes and highlights the theoretical, practical, and academic benefits of PBL implementation. These findings not only support previous research but also contribute novel insights that advance scholarly discourse on instructional innovation and critical thinking development in secondary education.

CONCLUSION

This study concludes that the Problem-Based Learning model is demonstrably effective in improving the critical thinking skills of secondary school students. Drawing directly from the results and discussion, the findings indicate that students who participated in Problem-Based Learning exhibited substantial improvements in higher-order cognitive abilities compared to their learning conditions prior to the intervention. These improvements were consistently observed across key dimensions of critical thinking, including problem identification, analytical reasoning, evaluation of evidence, logical decision-making, and reflective judgment. The conclusion affirms that traditional teacher-centered instructional approaches are insufficient for developing these skills and that student-centered, inquiry-oriented models such as Problem-Based Learning offer a more effective alternative.

The findings further confirm that the improvement in students' critical thinking skills is closely linked to the theoretical foundations underpinning Problem-Based Learning. From a constructivist perspective, students benefited from actively constructing knowledge through engagement with

authentic and meaningful problems. The learning process encouraged cognitive restructuring, allowing students to integrate new information with prior understanding. This active engagement, as discussed in the results, enabled learners to move beyond surface-level comprehension toward deeper conceptual understanding, which is essential for critical thinking development.

In line with Experiential Learning Theory, the study concludes that the experiential and reflective nature of Problem-Based Learning played a significant role in enhancing students' cognitive outcomes. Students were not only exposed to problem situations but were also given structured opportunities to reflect on their experiences, test their ideas, and revise their reasoning through collaboration and feedback. This cyclical learning process strengthened students' ability to think critically by linking experience with reflection and conceptualization, as evidenced by their improved performance in post-intervention assessments.

The conclusions also reinforce the relevance of Critical Thinking Theory, particularly the framework emphasizing reasonable and reflective thinking in decision-making. The results demonstrated that students became more adept at evaluating the credibility of information, distinguishing between assumptions and evidence, and justifying their conclusions logically. These outcomes indicate that Problem-Based Learning effectively embeds critical thinking processes within subject instruction, supporting the view that critical thinking is best developed through integrated pedagogical approaches rather than isolated skill training.

In relation to the main research problem, this study concludes that Problem-Based Learning provides a viable and effective response to the persistent challenge of low critical thinking skills among secondary school students. The findings show that when students are placed at the center of the learning process and encouraged to engage actively with complex problems, their cognitive engagement increases significantly. This shift from passive reception of information to active inquiry represents a fundamental improvement in instructional practice and aligns with contemporary educational goals.

The conclusions also address the research gap identified in the literature. While previous studies have reported mixed findings regarding the effectiveness of Problem-Based Learning, this study demonstrates that its success is highly dependent on structured implementation and theoretical alignment. By integrating constructivist, experiential, and critical thinking principles into the instructional design, the study provides clear evidence that Problem-Based Learning can be effectively applied in secondary school contexts. This contribution strengthens the empirical basis for adopting PBL at this educational level.

Furthermore, the study concludes that the objectives of the research have been successfully achieved. The investigation effectively examined the extent to which Problem-Based Learning enhances critical thinking skills and provided a comprehensive understanding of how the model influences students' cognitive development. The findings also support the theoretical, academic, and practical benefits outlined in the study. Theoretically, the research contributes to the refinement of learning theories by demonstrating their practical integration in classroom instruction. Academically, it enriches the literature on innovative pedagogical models and critical thinking development. Practically, it offers evidence-based guidance for educators seeking to improve learning outcomes through student-centered instruction.

In conclusion, this study affirms that Problem-Based Learning is an effective instructional model for fostering critical thinking skills among secondary school students. The conclusions derived from the results and discussion highlight the model's capacity to address key educational challenges, bridge existing research gaps, and support the development of higher-order cognitive skills. By grounding instructional practice in established learning theories and implementing Problem-Based Learning systematically, educators can create learning environments that better prepare students for the demands of the twenty-first century. This study therefore provides a strong foundation for the broader adoption of Problem-Based Learning in secondary education and for future research aimed at further enhancing critical thinking through innovative pedagogical approaches.

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