

Enhancing Student Learning Outcomes through Inquiry-Based Learning: A Systematic Literature Review

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Abstract

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This study aims to examine the effectiveness of the Inquiry-Based Learning (IBL) as a pedagogical approach to improving student learning outcomes across different educational levels. IBL positions students as active participants who engage in questioning, exploring, experimenting, and drawing conclusions through structured inquiry processes. A systematic literature review was conducted by analyzing twelve empirical studies selected through defined inclusion criteria, with data drawn from reputable national and international journals. The analysis employed a thematic approach to identify recurring findings and highlight differences across contexts. The results reveal that IBL contributes significantly not only to cognitive achievement, such as improved conceptual understanding and problem-solving skills, but also to affective development, including motivation, engagement, and positive attitudes toward learning. Moreover, IBL supports the growth of critical thinking, collaboration, and reflective practices essential for 21st-century education. Despite challenges related to teacher readiness, curriculum time, and resource availability, the findings emphasize that IBL, supported by teacher training, institutional commitment, and technology integration, holds strong potential for sustainable educational reform.

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1. Introduction

The quality of education is not solely defined by the completeness of curricula or the adequacy of learning facilities, but is also strongly shaped by the pedagogical approaches applied by teachers in the classroom. Employing learning models that align with the characteristics and demands of 21st-century learners can substantially enhance both instructional effectiveness and student achievement. One approach that has gained growing recognition in contemporary education is Inquiry-Based Learning (IBL) (Joseph et al., 2022). This model emphasizes active student participation in the learning process. Rather than functioning as passive recipients of knowledge, learners are engaged in activities such as direct observation, information gathering and analysis, data interpretation, and drawing conclusions derived from their own empirical experiences.

In this way, IBL positions students as novice researchers who construct understanding through systematic inquiry and investigation. Such a method stands in contrast to traditional teacher-centered approaches, where knowledge transmission is one-directional and students largely assume a passive role. Within the landscape of global education, where competition is increasingly intense, enhancing student outcomes has become a central priority for policymakers and practitioners alike. These outcomes encompass not only academic performance but also essential competencies such as critical thinking, creativity, collaboration, and problem-solving. Inquiry-Based Learning offers a dynamic and adaptable framework to nurture these skills, as it encourages learners to build meaning through structured

inquiry, interactive dialogue with peers, and reflective evaluation of their own discoveries (Manishimwe et al., 2022).

Recent studies consistently highlight that the implementation of Inquiry-Based Learning (IBL) has a significant influence on enhancing student achievement across key disciplines such as science, mathematics, and language. For instance, Maknun (2020) demonstrated that laboratory activities structured on inquiry principles substantially improved students' conceptual grasp of biology. In these activities, learners were not only engaged in experimental tasks but also guided to generate questions, construct hypotheses, and draw conclusions grounded in their observations and collected data (Kranz et al., 2023). Similarly, research by Qasemnazhand et al. (2024) on inquiry-based STEM projects revealed that this method boosts student motivation while also improving quiz scores following project completion. Such evidence suggests that IBL strengthens not only students' affective engagement but also their immediate academic performance.

Supporting this perspective, Choowong and Worapun (2021) examined the use of the Predict-Observe-Explain (POE) model within mathematics instruction and reported notable gains in conceptual understanding as well as overall mastery of mathematical content. The POE framework encourages students to forecast outcomes, directly observe processes, and articulate explanations based on their findings. This cycle fosters deeper comprehension and meaningful internalization of knowledge, which contributes to better long-term retention. Despite the promising outcomes identified in multiple studies, however, the application of IBL in classrooms is still accompanied by certain challenges that require attention.

One of the central challenges in applying Inquiry-Based Learning (IBL) lies in teacher preparedness to design and facilitate inquiry-driven activities effectively. Educators are expected to possess advanced pedagogical and methodological competencies, which include managing classrooms, guiding students throughout the inquiry process, and assessing learning outcomes that extend beyond cognitive mastery to procedural skills. Moreover, curriculum time limitations and restricted access to resources such as laboratories and instructional materials, often present barriers to the full implementation of IBL (Madina, 2024). For this reason, enhancing teacher training and continuous professional development becomes a crucial component of strategies aimed at strengthening IBL practices. Equally important is systemic support from schools and policymakers, particularly in ensuring the provision of sufficient resources and flexible curriculum structures to establish a supportive environment for IBL.

Within this literature review, the author seeks to examine diverse recent empirical findings that highlight the effectiveness of IBL in advancing student achievement. The objective is to present a holistic account of the positive contributions of IBL to students' academic growth and 21st-century competencies, while also offering practical recommendations for educators and policymakers. Ultimately, this effort is directed toward advancing the quality of education through the adoption of innovative, student-centered learning approaches.

2. Literature Review

2.1. Principles and Characteristics of Inquiry-Based Learning

Inquiry-Based Learning (IBL) is an instructional model that positions students as active participants in the process of questioning, investigating, and independently seeking solutions through structured inquiry activities. Instead of simply absorbing information, students are encouraged to nurture curiosity, formulate their own questions, and explore diverse sources in order to gain a more comprehensive understanding. Such a process creates a dynamic and contextual learning environment that directly strengthens curiosity, critical thinking, and analytical abilities (Rotikan et al., 2023). One of the central principles of IBL is the transformation of the teacher's role, from being the sole provider of knowledge to acting as a facilitator and mentor who accompanies students throughout the inquiry process.

In this model, teachers guide students to develop questions, gather and interpret data, and derive logical conclusions from their investigations. This fosters meaningful learning that is rooted in students' own experiences, making the acquired knowledge more relevant, memorable, and applicable in real-life contexts. By linking new concepts to prior knowledge and lived experiences, learners develop a stronger and more personalized comprehension, moving beyond mechanical memorization toward genuine understanding. A defining feature of IBL is the active involvement of students in all stages of the learning process. Activities such as conducting observations, carrying out experiments, participating in group discussions, and engaging in problem-solving tasks enable learners to grasp subject matter

conceptually while also cultivating broader competencies. These include essential 21st-century skills such as problem-solving, teamwork, and self-reflection, which are crucial for lifelong learning and personal development.

2.2. Impact of IBL on Academic and Affective Outcomes

A growing body of empirical research highlights that the implementation of Inquiry-Based Learning (IBL) has a considerable influence on enhancing student learning outcomes across subjects and educational levels. According to Arsyad et al. (2024), IBL not only improves students' comprehension of abstract chemical concepts but also fosters the development of systematic problem-solving abilities. Through this approach, learners are encouraged to generate hypotheses, carry out experiments, and derive conclusions from the data they gather on their own. As a result, their conceptual grasp becomes more profound and applicable in practice. Supporting this, A'tiyah et al. (2024) provided robust empirical evidence at the elementary school level, demonstrating that the integration of inquiry-based worksheets in Science and Social Studies (IPAS) lessons for fifth graders significantly boosted academic achievement.

Beyond academic performance, IBL has also shown benefits for students' affective dimensions. Findings from Newald (2022) revealed that inquiry-based approaches enhanced students' satisfaction with learning and fostered more positive perceptions of classroom activities. By creating an open, exploratory environment, IBL enables learners to feel acknowledged, motivated, and increasingly confident in voicing their ideas. Such conditions strengthen both engagement and personal

investment in the learning process, underscoring the holistic value of IBL in education.

2.3. Adapting Inquiry-Based Learning to Diverse Subjects

The Inquiry-Based Learning (IBL) model has been widely applied across multiple levels of education, ranging from primary to higher education, and within diverse subject areas. Its adaptable nature makes it possible to tailor IBL to curriculum objectives and the unique learning characteristics of students at each stage. At the secondary school level, Qasemnazhand et al. (2024) designed an inquiry-based project to introduce the concept of radioactivity. Through carefully structured exploration and experimentation, students were guided to investigate, formulate questions, and reach conclusions grounded in scientific evidence. The findings of this study demonstrated a notable improvement in student motivation and higher quiz scores, indicating both a deeper grasp of the content and increased engagement during the learning process.

In mathematics education, Choowong and Worapun (2021) employed the Predict-Observe-Explain (POE) strategy as a form of IBL. This model requires students to predict possible outcomes, observe actual phenomena, and then explain the consistency or discrepancy, between their predictions and the observed results. Such an approach was shown to significantly strengthen students' conceptual understanding. At the higher education level, Zhang et al. (2022) highlighted the effectiveness of a case-driven inquiry approach in Computer Professional English courses. By engaging students in solving real-world cases relevant to their future

professional contexts, this method succeeded in enhancing both learning outcomes and practical application skills.

3. Method

This research employed a systematic literature review method within a qualitative framework. The approach was designed to provide a comprehensive understanding of how Inquiry-Based Learning (IBL) contributes to enhancing student learning outcomes by synthesizing evidence from a range of scholarly sources. Data were systematically collected from both national and international academic journals. To ensure the review remained rigorous and well-focused, a set of inclusion criteria was applied to guide the selection of articles. These criteria specified that only empirical studies addressing the practical implementation of IBL in formal education, whether at the elementary, secondary, or higher education levels, would be considered. Furthermore, the selected studies needed to include indicators of improved learning outcomes as a central aspect of their analysis or findings, and all articles were required to be openly accessible and directly relevant to the relationship between IBL and student learning achievements.

The process of literature searching was conducted through the Google Scholar database, utilizing specific keywords such as “Inquiry-Based Learning,” “student learning outcomes,” and “active learning.” Following a strict selection procedure guided by the previously established inclusion criteria, a total of 12 studies were identified as eligible for further examination. Several of these publications were sourced from well-recognized journals, including the International Journal of

Education and Learning, Instructional Science, and IEEE Transactions on Education. Each selected article was subsequently examined using a thematic analysis approach, which served to highlight recurring patterns, as well as to compare similarities and distinctions across the different studies.

The analysis encompassed several key components, such as the educational context, the strategies employed in implementing IBL, the indicators used to measure learning outcomes, and the effects of implementation on both cognitive and affective domains of students. To guarantee the reliability and credibility of the results, validation procedures were applied through peer debriefing as well as thematic triangulation of data across the selected studies. Each piece of evidence was carefully cross-checked to assess consistency and strengthen the accuracy of the interpretations. The synthesized outcomes of this process were then organized into core themes, which are discussed in greater detail in the results and discussion section of this paper.

4. Results and Discussion

This extensive review highlights that the Inquiry-Based Learning (IBL) model plays a crucial role in enhancing student achievement across different educational stages, ranging from elementary to higher education. Within this framework, students are positioned as active participants rather than passive recipients of knowledge, as they are encouraged to construct questions, investigate phenomena, gather information, and draw conclusions through both independent inquiry and collaborative analysis. A wide range of empirical findings demonstrate that IBL

contributes not only to better cognitive performance but also to the advancement of affective development and higher-order thinking abilities (Lu et al., 2021).

The effectiveness of IBL is particularly evident in disciplines such as science, mathematics, and language learning, where it has been shown to strengthen conceptual mastery, foster active engagement, and cultivate critical and reflective thinking skills. For instance, Maknun (2020) found that integrating inquiry-based laboratory activities into biology instruction significantly enhanced students' analytical capacity while simultaneously boosting their interest in the subject. In this model, learners are not merely completing laboratory tasks in a routine manner; rather, they are challenged to formulate their own scientific questions, design relevant experiments, and analyze the resulting data. Such practices enrich conceptual comprehension while also developing authentic scientific skills within a practical and meaningful context.

At the primary school level, the positive influence of Inquiry-Based Learning (IBL) has been widely demonstrated through empirical studies. A'tiyah et al. (2024) showed that implementing inquiry-oriented worksheets in Science and Social Studies (IPAS) significantly improved students' grasp of fundamental concepts related to nature and society. Supported by quantitative findings, the research highlighted a substantial rise in class average scores following the adoption of this model. This suggests that inquiry-driven activities provide elementary students, who are typically in the concrete-operational stage of cognitive growth, with a more contextual and meaningful learning experience. By actively linking classroom material to everyday

life, IBL helps children build stronger, longer-lasting conceptual retention and understanding.

In secondary education, the benefits of IBL are also evident in enhancing the overall quality of learning. A notable example is the Predict-Observe-Explain (POE) strategy applied to mathematics instruction by Choowong and Worapun (2021). This model engages students by having them first predict the results of a mathematical situation, then observe the actual outcomes, and finally explain the connection or discrepancy, between their prediction and real findings. Such a process develops students' ability to think critically and reflectively, encouraging them to evaluate their reasoning patterns while recognizing both strengths and weaknesses in their problem-solving approaches. The study confirmed that the POE framework not only deepens students' understanding of mathematical concepts but also cultivates their metacognitive awareness.

The application of the IBL approach has also proven effective within the STEM (Science, Technology, Engineering, and Mathematics) domain, particularly at the secondary school level. Research by Qasemnazhand et al. (2024) demonstrated that students who participated in inquiry-driven STEM projects showed noticeable gains not only in learning motivation but also in their final performance outcomes. These projects, which often emphasize collaboration and problem-solving of real-world issues, provide students with opportunities to integrate and apply knowledge across multiple disciplines. Such results highlight that IBL is not limited to enhancing theoretical comprehension but also equips learners with practical skills and solution-oriented thinking necessary for navigating real-life challenges.

Beyond its cognitive benefits, IBL also has a substantial impact on students' affective dimensions of learning. Elements such as motivation, interest in the subject, and attitudes toward the learning process are equally vital for achieving lasting outcomes. In this context, Manishimwe et al. (2022) found that inquiry-based laboratory practices significantly improved students' positive perceptions of biology. By being more directly engaged in designing and conducting experiments, learners developed a stronger sense of responsibility and ownership of their academic journey. This empowerment fosters a more meaningful and student-centered learning atmosphere while also shaping long-term dispositions aligned with scientific thinking and character formation.

The findings of Manishimwe et al. (2022) reinforce the view that Inquiry-Based Learning (IBL) is a holistic instructional model capable of addressing all three domains in Bloom's taxonomy, namely cognitive, affective, and psychomotor. Students are not only able to demonstrate stronger academic achievement but also develop positive attitudes toward science, enhance their social interaction skills, and acquire procedural abilities that are critical for 21st-century learning. Nonetheless, the effective adoption of IBL remains challenged by several barriers identified in prior studies. Among the most pressing obstacles are the lack of targeted teacher training in inquiry-based pedagogies, the substantial amount of time required for inquiry activities that involve deeper exploration, and the limited availability of resources such as facilities, teaching materials, and technological support.

To address these barriers, researchers have put forward practical strategies aimed at strengthening the sustainability of IBL implementation. Madina (2024), for

instance, highlights the importance of practice-oriented professional development, where teachers actively engage in designing, applying, and reflecting on inquiry-based instruction within authentic classroom settings. Such experiential training proves more effective than theoretical workshops because it allows educators to confront challenges and discover workable solutions firsthand. Furthermore, the integration of digital tools presents another promising avenue to overcome time and resource constraints. According to Newald (2022), the use of online platforms, virtual simulations, and interactive digital resources can facilitate more flexible inquiry processes. These technologies not only allow students to engage in data exploration and experiment simulations but also enable them to collaborate and personalize their learning experiences beyond the confines of traditional classroom schedules.

From the synthesis of these findings, it can be inferred that Inquiry-Based Learning (IBL) holds strong potential as a comprehensive approach to enhancing student learning outcomes. Its contribution extends beyond the improvement of academic achievement, as it also nurtures students' development into active, critical, and reflective learners. For this reason, IBL should be seriously considered by educators and policymakers as a vital element in advancing sustainable educational reform. The successful application of this model depends on strong collaboration among teachers, schools, government bodies, and professional development institutions in building a learning ecosystem that encourages exploration, innovation, and student autonomy. With ongoing teacher capacity-building, adequate provision of infrastructure, and curriculum designs that allocate sufficient room for inquiry-

oriented activities, IBL can serve as a central strategy to meet the complex demands of 21st-century education.

5. Conclusion

Inquiry-Based Learning (IBL) has consistently demonstrated its effectiveness and relevance as a pedagogical model for enhancing student learning outcomes across diverse educational stages. By creating opportunities for active exploration, independent inquiry, and critical reflection, this approach not only strengthens the cognitive dimension of learning but also fosters intrinsic motivation, deeper engagement, and more positive attitudes toward the learning process. The literature examined in this review highlights that the success of IBL implementation is strongly influenced by several key factors, including teachers' preparedness and pedagogical competence, institutional commitment to providing adequate support, and the adaptation of inquiry-based strategies to suit specific classroom contexts.

Drawing on these insights, the study outlines several recommendations to ensure more sustainable implementation. These include continuous professional development programs that emphasize inquiry-oriented teaching practices, the integration of digital tools to facilitate online inquiry processes, and the use of formative assessments designed to monitor students' reasoning and cognitive growth. Looking ahead, future research is particularly needed to investigate the potential of IBL within hybrid learning environments that combine face-to-face and digital modalities, as well as the role of Artificial Intelligence (AI) in enriching inquiry activities by offering adaptive and personalized learning support.

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