

# Problem-Based Learning Approaches for Teaching Innovation in Higher Education: A Mini Review

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## ABSTRACT

Higher education must undergo continuous transformation to equip students with critical thinking skills required to meet national and societal demands. Improving teachers' skills is crucial in this situation, especially when it comes to teaching cutting-edge courses. Thus, this article explores the benefits of problem-based learning (PBL), the difficulties in putting it into practice, the gaps in the literature, and possible avenues for further research.

**Keywords:** Innovation, Education, Problem base Learning Approach.

## INTRODUCTION

The Malaysia Education Blueprint 2013-2025 (MEB) shows the critical role of fostering innovation among school-aged students (Malaysia Ministry of Education, 2013). This emphasis on innovation extends beyond primary and secondary education, advocating for its integration into higher education curricula to equip students with pertinent skills necessary for the competitive job market. The overarching goal, articulated by the Ministry of Education Malaysia (2020), is to enhance student learning at all educational levels through the incorporation of Information and Communication Technology (ICT) and blended learning methodologies. Complementing MEB, the Ministry introduced the Digital Education Learning Initiative Malaysia (DELIMa) in 2020, aimed at further embedding digital competencies within teaching practices. Prior to these initiatives, research by Zainol and Abdullah (2025) revealed that fewer than 80% of teachers utilized ICT for less than one hour per week, highlighting a significant gap in digital integration

In another, the advent of the COVID-19 pandemic precipitated an unprecedented shift in educational delivery worldwide, compelling institutions from kindergarten to university levels to transition rapidly from traditional face-to-face instruction to online learning modalities, termed *Pengajaran dan Pembelajaran di Rumah (PdPR)* in Malaysia. This transition involved the adoption of various digital platforms such as Microsoft Teams, Zoom, Google Classroom, and WhatsApp to facilitate virtual classrooms (Somabut et al., 2024). Consequently, teaching innovation accelerated markedly, encompassing pedagogical strategies, technological application, and institutional practices using Learning Management Systems (LMS) and digital content creation (Rusli et al., 2023; Chen & Teh, 2022). Despite these advancements, the abrupt change posed significant challenges concerning readiness, digital infrastructure, and technological proficiency among educators, students, and institutions (Hong, 2024; Chen & Teh, 2022). Post-pandemic, the trajectory of teaching innovation has evolved from emergency responses to deliberate, sustainable, and strategic transformations, characterized by the institutionalization of blended and hybrid learning models (Somabut et al., 2024).

Aligned with Malaysia's Sustainable Development Goals (SDG) 2021-2025, innovation is central to SDG Goal 9, which focuses on industry, innovation, and infrastructure. Higher education innovation courses encompassing Artificial Intelligence (AI), Internet of Things (IoT), and social entrepreneurship are pivotal in equipping students with Education 4.0 competencies. These programs not only stimulate creativity and employability but also support national objectives to foster economic growth and address societal challenges. Key strategies include project-based learning, startup incubators such as the Malaysian Global Innovation & Creativity Centre (MaGIC), and collaborative partnerships between universities and industry sectors. Rais et al. (2025) emphasize that innovative education prepares students to navigate the demands of the Fourth Industrial Revolution (IR 4.0),

embracing emerging technologies like AI, machine learning, and IoT, while promoting blended and hybrid learning pedagogies.

Recognizing the increasing significance of innovation education in higher learning institutions, diverse student-centered pedagogical approaches have been adopted to enhance innovation-related competencies. Notably, learning analytics has gained prominence by utilizing data to personalize learning experiences and monitor student progress (Bahari et al., 2023). Additionally, problem-based learning, which prioritizes real-world problem-solving and critical thinking skills, has attracted considerable attention as an effective method for cultivating innovation (Mulawarman, 2024). This paper thus aims to review the benefits of using problem-based learning approaches in teaching innovation within higher education, contributing to the development of pedagogies that foster the necessary skills for future-ready graduates.

## **Problem-Based Learning Approaches for Teaching Innovation in Higher Education**

### **An Overview of Problem-Based Learning Approaches**

Problem-Based Learning (PBL) is an educational methodology centered on addressing real-world problems, fostering interdisciplinarity, critical thinking, and active learning (Chang, Wang, Haynes, Song, Lai, & Hsieh, 2022). Recognized as an innovative student-centered approach, PBL emphasizes collaborative problem-solving, encouraging creativity, critical thinking, and innovation within higher education. Its relevance to innovation stems from its practical orientation, interdisciplinary collaboration, and the application of theoretical knowledge to authentic scenarios.

Rooted in constructivist learning theories, PBL posits that knowledge is best constructed through active engagement with complex, authentic problems rather than passive information reception. Ill-structured, real-world problems serve as the learning framework, compelling students to identify knowledge gaps, seeking information, and iteratively refine solutions (Sukacke et al., 2022; Smith et al., 2022). Originating in medical education in the late 1960s to enhance clinical decision-making, PBL has since expanded across diverse disciplines such as engineering, law, psychology, nursing, and social sciences, where problem-solving and professional judgment are paramount (Smith et al., 2022).

Fundamentally, PBL operates as a student-centered pedagogy wherein learners collaborate in teams, assume responsibility for their learning, and engage in self-directed inquiry. In this model, educators transition from knowledge transmitters to facilitators and scaffolds of the learning process (Sukacke et al., 2022; Made et al., 2023). Through collaboration, dialogue, and reflection, students build an extensive, flexible knowledge base, develop effective problem-solving strategies, and cultivate lifelong learning skills (Smith et al., 2022; Sukacke et al., 2022). These characteristics align PBL with broader student-centered educational approaches that prioritize autonomy, interaction, and active engagement over rote memorization (Tang, 2023).

A substantial and growing body of research links PBL to the enhancement of higher-order thinking and innovation-related competencies. Systematic reviews and empirical studies demonstrate that PBL improves critical thinking, creativity, and problem-solving across disciplines including mathematics, geography, nursing, and graduate education (Asri et al., 2024; Made et al., 2023). Students immersed in PBL environments exhibit heightened abilities to analyze complex situations, generate original ideas, and transfer theoretical knowledge into practice—capacities essential for innovation in dynamic, contemporary work settings (Weng et al., 2022; Rosario & Raimundo, 2024). Particularly in STEM and engineering education, PBL is lauded as a robust framework for integrated interdisciplinary learning, enabling students to connect concepts across domains while tackling authentic, socially relevant challenges (Smith et al., 2022; Sukacke et al., 2022).

In sum, PBL represents a contemporary educational paradigm that not only enhances academic understanding but also systematically nurtures the creative, critical, and collaborative skills necessary for innovation and effective real-world problem-solving in higher education and beyond (Asri et al., 2024; Weng et al., 2022; Made et al., 2023).

Although problem-based learning (PBL) is largely acknowledged as a successful student-centered strategy, its

efficacy varies depending on the situation. Studies that have already been conducted usually emphasize how it can improve critical thinking, creativity, and engagement; however, these results are largely dependent on elements like student readiness, facilitator competence, and learning environment.

For example, although PBL encourages active learning and teamwork, some research indicates that students who are not good at self-directed learning could find it difficult to reap the full benefits of this method. Similar to this, while PBL is linked to enhanced problem-solving skills, its application can require a lot of resources and could not produce the same results in other academic fields. This suggests that PBL's effectiveness should be seen as influenced by context rather than intrinsic, necessitating careful evaluation of institutional, pedagogical, and technological aspects.

### **Benefits of Problem-Based Learning**

Problem-Based Learning (PBL) offers significant advantages for teaching innovation, primarily through fostering active learning, engagement, skill development, and enhancing innovation and creativity. Central to PBL is its capacity to engage students in addressing real-world problems, thereby promoting critical thinking, teamwork, and self-directed learning (Prada Núñez, Hernández-Suarez & Gamboa Suarez, 2022). This approach is especially effective in disciplines such as engineering, information technology, and design, where applying theoretical knowledge to practical scenarios is crucial (Darus et al., 2016).

PBL fundamentally transforms traditional pedagogical methods by shifting the learning environment to a dynamic, student-centered model. This transformation encourages learners to actively participate in problem-solving, which enhances intrinsic motivation and engagement. For example, students may work collaboratively on case studies, clinical scenarios, engineering projects, or other group assignments that require them to propose solutions based on diverse resources such as company reports, newspaper articles, and magazines (Nutt, Karu & Raamets, 2023; Gonzalez-Argote & Castillo-González, 2024). Such involvement in meaningful tasks not only deepens understanding but also cultivates essential skills. Empirical evidence supports that active learning combined with PBL increases classroom engagement and improves examination outcomes, leading to higher course pass rates compared to traditional teaching methods (Kallemeyn et al., 2021).

Beyond engagement and skill acquisition, PBL plays a pivotal role in nurturing innovation and creativity. It incorporates structured thinking frameworks like the Two-Tier Mandala Thinking approach, which integrates divergent and convergent thinking processes to refine innovative ideas. This methodology has been demonstrated to enhance students' creative self-efficacy and confidence in innovation-related tasks (Basri, Salija, Baa & Muhammad, 2024). Furthermore, PBL-designed courses, particularly those emphasizing entrepreneurship and innovation, immerse students in authentic challenges such as developing business models, participating in ideathons, hackathons, and delivering pitch presentations. These activities are instrumental in fostering entrepreneurial skills and innovative mindsets (Kabilan, 2024; Huang, Chung & Lou, 2022).

By centering learning on real-life problems, PBL effectively bridges the gap between academic knowledge and practical application. It emphasizes critical thinking and problem-solving abilities that underpin innovation, enabling students to analyze complex issues, generate solutions, and iteratively refine their ideas. Students engage with ill-structured, authentic problems that mirror entrepreneurial challenges, including business model development, prototype creation, and sustainability considerations (Bell, 2008; Voldsund, Hasleberg & Bragelien, 2020). This approach has also been shown to enhance creativity and logical reasoning in diverse fields such as legal studies and administrative law (Hews, Beligatamulla & McNamara, 2023). In applied disciplines like engineering and public administration, PBL facilitates the development of solutions addressing societal and industry-specific issues, thereby fostering entrepreneurial competencies and innovation (Chang, 2025). For instance, food engineering students employing PBL successfully created innovative products for industry competitions, illustrating PBL's capacity to stimulate entrepreneurial spirit and practical creativity (Oliveira & Cardoso, 2021).

In summary, PBL's dual benefits lie in its ability to activate student engagement and skill development through active, problem-centered learning, and in its promotion of innovation and creativity by connecting academic inquiry with real-world entrepreneurial challenges. This holistic approach equips students with the cognitive and

practical tools necessary to thrive in complex, evolving professional landscapes.

## METHODOLOGY

The usefulness of problem-based learning (PBL) in teaching innovation in higher education is investigated in this study using a mini systematic review methodology. This approach's goal is to find, evaluate, and synthesise pertinent literature to offer a thorough grasp of the advantages, constraints, and research gaps related to PBL.

An organised search of reputable academic databases, such as Google Scholar, Scopus, and ScienceDirect, was used to find pertinent publications. A variety of terms, including "problem-based learning," "innovative teaching," "innovative education," "student engagement," and "higher education," were used in the search. The search was narrowed and pertinent results were guaranteed by using boolean operators (AND, OR).

The review's inclusion criteria were as follows: (1) peer-reviewed journal articles; (2) English-language publications; (3) research on problem-based learning or creative teaching approaches in higher education; and (4) articles published between 2015 and 2024 to guarantee the inclusion of current and pertinent findings. Excluded were articles with no theoretical or empirical significance, non-academic sources, and studies that concentrated on elementary or secondary education.

There were two phases to the screening procedure. Initially, titles and abstracts were examined to see if they were pertinent to the topic of the study. Second, full-text articles were reviewed to make sure they met the requirements for inclusion. For additional analysis, only studies that specifically addressed how PBL improves learning outcomes, student engagement, or competencies related to innovation were chosen.

A theme analysis technique was used to examine the chosen articles. Important themes were found, such as the advantages of PBL, implementation difficulties, and new research gaps. In order to provide an organised overview of the existing state of research and to create a logical framework for future research initiatives, these themes were subsequently critically analysed and synthesised.

### Research gaps and future directions

Even though problem-based learning (PBL) has been studied extensively, there are still a few important gaps in the literature that prevent a thorough understanding of PBL's efficacy in higher education. Four essential dimensions can be used to summarise these gaps.

#### Gap in Facilitator Competency

Few empirical studies have looked at how facilitator skill affects student results, despite PBL's emphasis on educators' roles as facilitators. Without rigorously examining differences in teaching methods and their effects on learning effectiveness, most of the research presume effective facilitation. Nonetheless, research suggests that students' learning processes and higher-order thinking abilities are strongly impacted by facilitator performance (Dolmans et al., 2019). Additionally, it has been demonstrated that in PBL settings, good facilitation is essential for fostering student involvement and knowledge creation (Hmelo-Silver, 2018).

Question for further research: What effects do pedagogical competency and facilitator training have on learning outcomes and student engagement in PBL settings?

#### The Gap in Student Readiness

Although PBL necessitates that students exhibit self-directed learning, motivation, and critical thinking, little study has been done on how variations in student preparation affect its efficacy, especially when it comes to students from elective courses or non-core fields (Kim, Belland, & Walker, 2018; Chang, Hill & Hannafin, 2020).

Question for further research: What effects do student traits like motivation, preparedness for learning, and cognitive abilities have on PBL success?

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## The Gap in Technology Integration

Digital tool integration in PBL is becoming more and more crucial, particularly in online and hybrid learning settings. However, little research has looked at how access to digital infrastructure and technology preparedness impact learning outcomes in PBL settings (Bond, Buntins, Bedenlier, Zawacki-Richter & Kerres, 2020; Dhawan, 2020).

Question for further research: How might technological readiness improve PBL's efficacy in digital and hybrid learning environments?

## Contextual and Disciplinary Gap

With little research done in other areas like business and management, the majority of PBL studies are focused on STEM and medical education. This calls into question whether PBL can be applied across disciplines with various student profiles and learning objectives (Servant-Miklos, 2019).

Question for further research: How does PBL's efficacy differ throughout academic fields, especially in business and management education?

## Evaluation Framework Deficit

When evaluating PBL outcomes, few comprehensive frameworks account for institutional, cultural, and student-related variations. Studies currently conducted often rely on discrete performance metrics without considering the full learning process (Dolmans, 2019).

Future research questions: What frameworks for integrated evaluation may be created to evaluate the efficacy of PBL in various educational settings?

## CONCLUSION

Several important findings about the application of problem-based learning (PBL) may be taken from the analysed studies. First, although its efficacy varies based on the learning context and style of delivery, PBL has been repeatedly demonstrated to improve critical thinking, teamwork, and communication—all crucial 21st-century abilities. Second, contextual elements such as facilitator competency, resource availability, technical support, and alignment with institutional and cultural settings are critical to the successful implementation of PBL. Third, despite its pedagogical advantages, PBL continues to encounter issues with student preparedness, time restrictions, and group dynamics, suggesting that both structural support and participant readiness are essential for attaining the best possible learning results.

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