



KEMENTERIAN PENDIDIKAN TINGGI

PITRAM 2026

Pertandingan Inovasi Antara Asasi Malaysia

Extended Abstract Book



11 dan 12 APRIL 2026

Dewan Berlian

Universiti Teknologi MARA

Cawangan Selangor

Kampus Puncak Alam



UNIVERSITI
TEKNOLOGI
MARA

Pusat
Asasi



KEMENTERIAN PENDIDIKAN TINGGI



MAJLIS DEKAN/PENGARAH ASASI
UNIVERSITI AWAM MALAYSIA

PBL PLUS: A Student-Driven Innovation in Biology Education for Sustainable and Real-World Problem Solving

Rohaiza Daud, Mohamad Fhaizal Mohamad Bukhori, Mohamad Razif Othman, Roberta Chaya Tawie Tingga, Christharina S Gintoron, Mohd Ridwan Abd Rahman @ Tahir, Mohd Aminudin Mustapha

Department of Biology, Centre for Pre Universiti Studies, Universiti Malaysia Sarawak,
94300 Kota Samarahan, Sarawak Darul Hana, Malaysia

*drohaiza@unimas.my

ABSTRACT

This study introduces PBL PLUS, an enhanced Problem-Based Learning approach designed to strengthen engagement, critical thinking, scientific communication, and real-world problem-solving in biology education. Unlike conventional PBL, which commonly uses predefined scenarios, PBL PLUS allows students to identify and investigate their own research problems within broad environmental themes such as wildlife conservation, plant diversity, and river ecosystem health. Implemented in a foundation-level biology course with a large student cohort, the approach required students to produce research-based posters, extended abstracts, and oral presentations, later compiled into an academic bulletin. Based on student feedback, a highly positive response was observed with 65.1% strongly agreeing and 29.3% agreeing that PBL PLUS improved their understanding of course topics. The findings suggest that PBL PLUS supports meaningful learning by connecting biological concepts with real environmental issues while promoting sustainability awareness in line with SDG-oriented education. Overall, PBL PLUS offers a flexible and scalable model for student-centred biology education and real-world problem solving.

Keywords: Problem-Based Learning (PBL PLUS), Biology Education, Student-Centred Learning, Scientific Inquiry, Sustainability Education, SDGs

1. INTRODUCTION

The increasing demand for graduates equipped with critical thinking, problem-solving, and communication skills has driven the adoption of student-centered learning approaches in higher education (Bell, 2010). Problem-Based Learning (PBL) is widely recognized as an effective pedagogical strategy that promotes active learning, student engagement, and deeper understanding (Almulla, 2020). However, conventional PBL approaches that rely heavily on predefined problem scenarios may reduce opportunities for student autonomy, choice, and self-directed exploration, which are considered important elements in meaningful project-based experiences (Bell, 2010; Barak, 2012).

Despite the integration of PBL in biology education, students often remain partially passive due to structured problem boundaries, which can limit creativity, engagement, and real-world application. This is particularly evident in environmental and biodiversity topics, where authentic, context-driven inquiry is essential for meaningful learning (Rachman et al., 2020). As a result, students may struggle to connect theoretical concepts with practical environmental challenges, reducing the overall impact of the learning experience. In response to this concern, PBL PLUS was developed as an enhanced form of Problem-Based Learning that gives students

more room to choose, explore, and communicate environmental issues that are meaningful to them.

To address this need, this study introduces PBL PLUS, an enhanced adaptation of Problem-Based Learning (PBL) that emphasises student autonomy, contextual problem identification, and the production of authentic scientific outputs. Unlike conventional PBL, where problems are typically predefined, PBL PLUS enables students to define specific issues within broader thematic contexts, thereby fostering deeper engagement and ownership of the learning process. This study aims to: (i) implement PBL PLUS as an innovative pedagogical approach in Biology education, (ii) enhance students' engagement, critical thinking, and scientific communication skills through student-driven inquiry, and (iii) evaluate its effectiveness based on student outputs and feedback.

2. METHODOLOGY

This study adopted a pedagogical implementation approach to evaluate the effectiveness of PBL PLUS in enhancing student learning in Biology. The study involved approximately 215 pre-university students at Universiti Malaysia Sarawak (UNIMAS), who were organised into collaborative groups. The study employed an instructional innovation design based on the PBL PLUS framework, implemented in a foundation-level biology course with a large student cohort.

2.1 Innovation Framework

The implementation of PBL PLUS was guided by a structured innovation framework (Figure 1), designed to promote student-driven inquiry and meaningful learning through real-world contexts. The framework begins with a thematic trigger, where authentic environmental issues are introduced as the starting point of learning. These themes serve as open-ended prompts that encourage students to explore relevant and current challenges in biodiversity and sustainability. Following this, students engage in inquiry and exploration, involving comparative analysis, guided research, and investigation of selected topics. This stage allows students to actively construct knowledge rather than passively receive information. This collaborative structure reflects student-centered pedagogical practices that support active participation, dialogue, and shared responsibility in learning (Virtue & Hinnant-Crawford, 2019). The next stage focuses on product and solution development, where students translate their findings into tangible scientific outputs, such as research posters, extended abstracts, and presentations. This stage emphasizes the application of knowledge and the development of communication skills. Finally, the framework concludes with reflection, where students evaluate their learning experiences and receive feedback for continuous improvement. This reflective process is essential in reinforcing understanding and enhancing future learning outcomes.

In addition, the framework aligns with sustainability-oriented education by integrating real-world environmental themes into student learning. The implementation of PBL PLUS is closely associated with SDG 4 (Quality Education) through student-centred learning, as well as SDG 13 (Climate Action) and SDG 15 (Life on Land) through the exploration of environmental issues such as biodiversity and ecosystem health. The collaborative nature of the activities also reflects SDG 17 (Partnerships for the Goals), as students work together to develop solutions and communicate scientific findings. This integration of PBL with sustainability-related themes is important in supporting critical thinking and meaningful learning within SDG-oriented education (Yonanda et al., 2023).

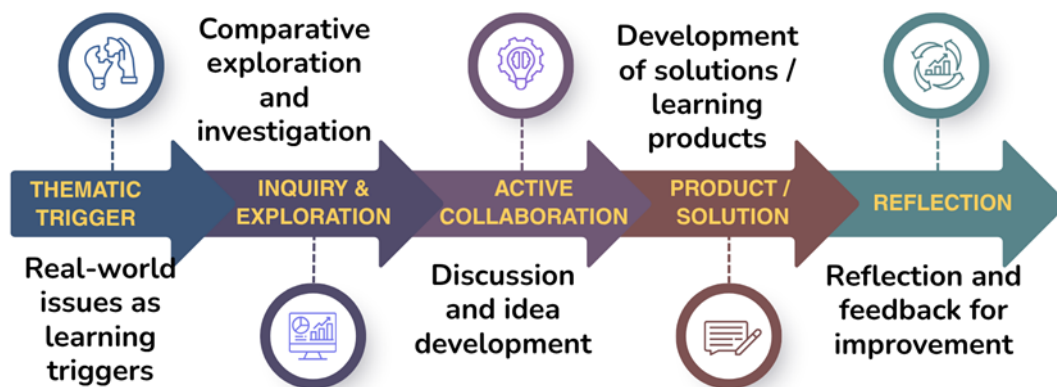


Figure 1. PBL PLUS Implementation Framework

2.2 Data Collection and Analysis

Student feedback was collected using structured Likert-scale questionnaires focusing on engagement, understanding, collaboration, and communication. Descriptive analysis was used to summarize responses, particularly the distribution of agreement levels.

3. RESULTS AND DISCUSSION

Figures 2 and 3 present students' perceptions of the implementation of PBL PLUS in relation to conceptual understanding and learning engagement. As shown in Figure 2, students demonstrated a highly positive response to the statement "The PBL PLUS activity helped me understand the course topics better." A total of 65.1% of students strongly agreed, while 29.3% agreed, resulting in an overall positive response of 94.4%. This indicates that PBL PLUS was effective in supporting students' understanding of biological concepts. The integration of problem-based tasks, collaborative discussion, and real-world contexts likely encouraged active engagement with the content, allowing students to construct knowledge more meaningfully rather than passively receiving information. This is consistent with the principles of problem-based learning, which emphasise active knowledge construction, collaboration, and deeper cognitive processing (Almula, 2020; Kokotsaki et al., 2016).

In contrast, Figure 3 shows a more varied response pattern for the statement "This activity was more engaging than traditional lectures." Although the majority of students responded positively (60.9% agree; 9.8% strongly agree), a notable proportion (27.4%) strongly disagreed. This suggests that while PBL PLUS was generally perceived as engaging, not all students responded equally to the approach. Such variation may be explained by differences in students' familiarity with student-centred learning environments. Learners who are more accustomed to traditional lecture-based instruction may initially perceive active learning approaches as more demanding or less structured due to the shift from passive content delivery to inquiry- and collaboration-based learning environments (Hafeez, 2021).

The contrast between the strong positive response for conceptual understanding and the more diverse response for engagement highlights an important consideration in the implementation of active learning strategies. While PBL PLUS appears highly effective in achieving its primary learning outcomes, student engagement is influenced by multiple factors, including individual learning preferences, group interaction, clarity of task design, and the effectiveness of

facilitation. Therefore, the role of the facilitator is crucial in guiding discussions, ensuring participation, and supporting students throughout the learning process, as effective facilitation is essential of maintaining meaningful engagement in PBL environment (Salinitri et al., 2015).

Overall, the findings demonstrate that PBL PLUS is a promising pedagogical innovation in Biology education. It provides strong support for conceptual understanding while offering generally positive, although varied, impacts on student engagement. Continuous refinement in instructional design and facilitation strategies is recommended to enhance student acceptance and maximise the benefits of this student-centred approach. These findings further support the growing body of evidence that active learning approaches can improve student learning outcomes and participation in science education (Rachman et al., 2020).

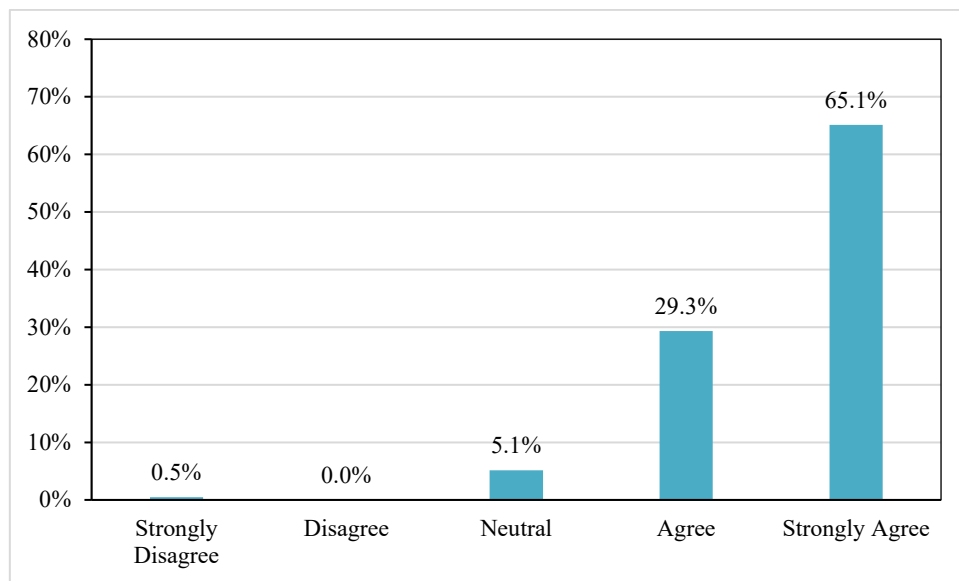


Figure 2. Students' Perception of PBL PLUS in Supporting Conceptual Understanding

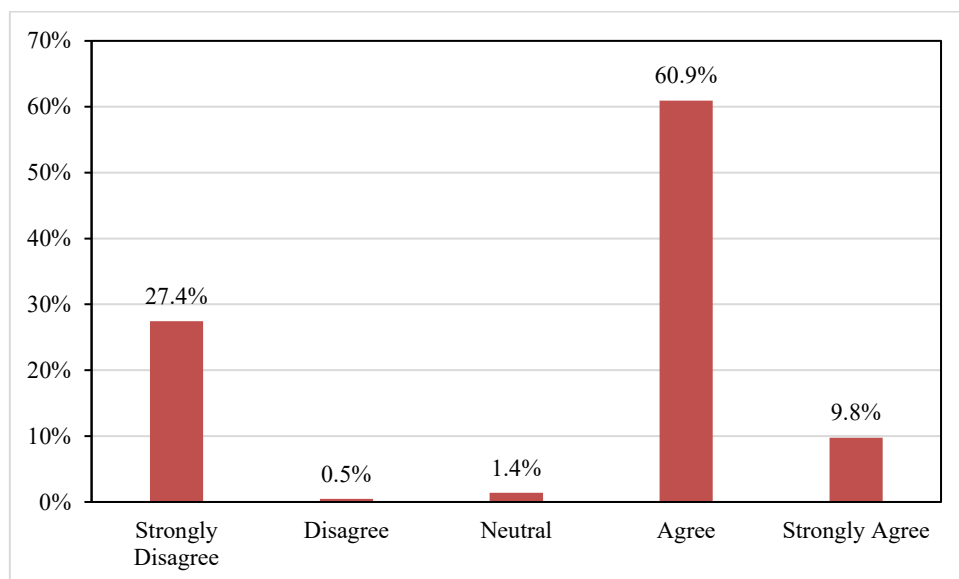


Figure 3. Students' Perception of PBL PLUS as an Engaging Learning Approach Compared with Traditional Lectures

4. CONCLUSION

PBL PLUS represents a significant advancement in biology education by extending the conventional PBL model into a more flexible and student-driven approach. The findings indicate that the approach effectively enhances student engagement, critical thinking, and scientific communication skills. By linking classroom learning to real-world environmental challenges, PBL PLUS supports meaningful and impactful learning aligned with sustainability goals. The framework is adaptable and scalable, offering strong potential for broader implementation across disciplines and educational contexts.

ACKNOWLEDGEMENT

The authors would like to express their sincere appreciation to the Centre for Pre-University Studies and Universiti Malaysia Sarawak (UNIMAS) for their continuous support and encouragement throughout the implementation of this initiative. Special thanks are also extended to all students involved in the PBL PLUS activities for their active participation and commitment.

REFERENCES

- Almulla, M. A. (2020). The effectiveness of the project-based learning (PBL) approach as a way to engage students in learning. *SAGE Open*, 10(3). <https://doi.org/10.1177/2158244020938702>
- Barak, M. (2012). From 'doing' to 'doing with learning': Reflection on an effort to promote self-regulated learning in technological projects in high school. *European Journal of Engineering Education*, 37(1), 105–116. <https://doi.org/10.1080/03043797.2012.658759>
- Bell, S. (2010). Project-based learning for the 21st century: Skills for the future. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, 83(2), 39–43. <https://doi.org/10.1080/00098650903505415>
- Hafeez, M. (2021). Project-based versus traditional lecture teaching methods. *Indonesian Journal of Social Science Research*, 2(1), 10–20. <https://doi.org/10.11594/ijssr.02.01.02>
- Kokotsaki, D., Menzies, V., & Wiggins, A. (2016). Project-based learning: A review of the literature. *Improving Schools*, 19(3), 267–277. <https://doi.org/10.1177/1365480216659733>
- Rachman, I., Sugimaru, C., & Matsumoto, T. (2020). Use of problem-based learning (PBL) model to improve learning outcomes in environmental education. *Journal of Environmental Science and Sustainable Development*, 3(1). <https://doi.org/10.7454/jessd.v3i1.1039>
- Salinitri, F. D., Wilhelm, S. M., & Crabtree, B. L. (2015). Facilitating facilitators: Enhancing PBL through a structured facilitator development program. *Interdisciplinary Journal of Problem-Based Learning*, 9(1). <https://doi.org/10.7771/1541-5015.1509>

- Virtue, E., & Hinnant-Crawford, B. (2019). "We're doing things that are meaningful": Student perspectives of project-based learning across the disciplines. *Interdisciplinary Journal of Problem-Based Learning*, 13(2). <https://doi.org/10.7771/1541-5015.1809>
- Yonanda, H. D., Istiana, R., & Prasaja, D. (2023). The influence of problem-based learning (PBL)-based student worksheets on sustainable development goals (SDGs) to improve students' critical thinking skills. *Journal of Biology Education Research (JBER)*, 4(2), 51–62. <https://doi.org/10.55215/jber.v4i2.6363>