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Application Of Practicum-Based Project Based Learning to Improve Science Literacy and Student Participation in Elementary School

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ABSTRACT

Science learning in elementary schools is often dominated by conventional methods, resulting in low science literacy and limited student participation. This study aims to examine the effectiveness of practicum-based Project Based Learning in improving science literacy and student participation. A quantitative approach with a one-group pretest–post-test design was employed involving 34 fifth-grade students. Data were collected through science literacy tests and observation sheets of student participation. The results showed a significant improvement in students' science literacy, with the average score increasing from 68.41 to 86.76 and an N-Gain score of 0.58, categorized as moderate. In addition, student participation improved as reflected in increased engagement during discussions, experiments, and project activities. These findings indicate that practicum-based Project Based Learning provides meaningful learning experiences and effectively enhances both science literacy and student participation.

1. Introduction

Science education in elementary schools plays a strategic role in shaping the foundation of critical thinking, problem-solving skills, and scientific understanding in early childhood. However, in practice, science learning is still often theoretical and not contextualized with students' real-life environments. Many students experience difficulties in understanding abstract scientific concepts due to the lack of hands-on activities and environmental exploration. Research indicates that environment-based learning can significantly improve students' science process skills (Pratiwi et al., 2020). Furthermore, contextual learning approaches have been shown to enhance students' conceptual understanding in science education (Yuliana et al., 2022).

The issue becomes more complex when considering students' scientific literacy, which remains relatively low. Scientific literacy not only involves understanding scientific concepts but also the ability to apply knowledge in everyday life and to adopt scientific attitudes toward social and

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environmental issues. Previous studies highlight that low scientific literacy is often caused by the lack of contextual and meaningful learning experiences (Puspitasari et al., 2020). In addition, effective learning strategies that promote critical thinking and problem-solving are essential to improve scientific literacy (Sari & Rahayu, 2022). Project-based learning has been identified as an approach that can develop students' critical thinking skills and enhance conceptual understanding through meaningful learning experiences (Affandi et al., 2023; Nugraheni et al., 2023).

In addition to scientific literacy, student participation in the learning process is another critical issue. Many students tend to be passive and show low enthusiasm in science learning, which negatively affects their motivation and learning outcomes. The lack of instructional variation contributes to limited student engagement (Ramdani et al., 2021). A less interactive classroom environment also reduces students' interest and involvement in learning activities (Lestari et al., 2022). Therefore, implementing instructional approaches that actively involve students is essential to improve both engagement and learning outcomes (Iskandar & Febriani, 2020).

One of the approaches considered effective in addressing these issues is Project Based Learning (PjBL). This model emphasizes learning through meaningful real-world projects, encouraging students to think critically, collaborate, and gain knowledge through direct experience. Studies have shown that PjBL improves conceptual understanding and collaborative skills (Nurlaili et al., 2020). It also promotes active participation and scientific attitudes among students (Wahyuni et al., 2021). Moreover, PjBL strengthens scientific literacy by engaging students in contextual problem-solving activities (Zubaidah et al., 2023).

Previous research further confirms that PjBL enhances students' motivation, conceptual understanding, and communication skills. Its active and contextual nature makes learning more engaging and relevant to students' lives. PjBL has been found to increase students' enthusiasm and motivation in science learning (Herlita et al., 2023). It is also effective in strengthening critical thinking skills (Gurning et al., 2023) and promoting active participation through teamwork and direct exploration (Jannah et al., 2023).

To maximize the effectiveness of PjBL, it should be integrated with practicum activities that provide hands-on scientific experiences. Practicum allows students to engage directly in scientific processes such as observation, experimentation, measurement, and data recording. The integration of practicum into learning has been proven to enhance conceptual understanding and science process skills (Susilawati et al., 2024). Additionally, contextually designed practicum activities can increase students' interest and active participation in learning (Diani et al., 2025).

The combination of Project Based Learning and practicum creates meaningful learning experiences by involving students in scientific exploration and inquiry processes. This active involvement stimulates both cognitive and emotional engagement, thereby strengthening students' understanding of the subject matter. Research shows that such integration significantly improves the quality of learning outcomes (Darmayani et al., 2024). Furthermore, it encourages students to think critically, conduct experiments, and relate scientific concepts to real-life situations (Riana et al., 2024).

The ecosystem topic is particularly suitable for implementing practicum-based PjBL because it is closely related to students' daily lives and can be directly observed in their surroundings. Students can explore ecosystems through simple projects such as creating terrariums, observing food chains, or mapping local environments. These activities promote active engagement in scientific processes (Latifah et al., 2023) and help students connect theoretical concepts with real-life experiences (Oktaviani & Fadillah, 2020). Contextual ecosystem learning also enhances students' understanding and environmental awareness (Wulandari et al., 2019).

Moreover, ecosystem-based learning through practicum-based PjBL contributes to the development of environmental awareness and social responsibility. By understanding the relationships among ecosystem components, students are encouraged to think ecologically and recognize their role in maintaining environmental balance. Studies show that such approaches foster environmental awareness from an early age (Ardoin et al., 2020) and strengthen social responsibility through field-based learning experiences (Holstermann et al., 2017). Direct ecosystem-based learning also promotes sustainable environmental behavior among students (Fitriana et al., 2021).

Despite these advantages, previous studies still show limitations. Most research focuses either on PjBL or practicum separately, without integrating both approaches systematically. In addition, studies that specifically examine the integration of practicum-based PjBL in ecosystem learning at the elementary school level are still limited, particularly those that simultaneously investigate scientific literacy and student participation. This indicates a clear research gap in developing and implementing an integrated learning model that addresses both aspects simultaneously.

Field observations conducted at SD Negeri 48 Banda Aceh reveal that science learning, particularly on ecosystem topics, is still dominated by teacher-centered lecture methods. This approach results in passive learning environments with minimal student interaction and limited opportunities for hands-on exploration. Consequently, students face difficulties in understanding complex and abstract ecosystem concepts. Furthermore, innovative approaches such as PjBL and practicum-based learning have not been optimally implemented, despite their potential to connect learning with real-life contexts.

The lack of active learning strategies also contributes to low student participation in discussions, practical activities, and group projects. This condition affects students' motivation, critical thinking skills, and scientific attitudes, as well as their environmental awareness. In the context of the Merdeka Curriculum, which emphasizes student-centered and differentiated learning, this situation highlights a gap between curriculum expectations and classroom practices.

Therefore, this study introduces a novel approach by integrating Project Based Learning with practicum activities in a structured and contextual manner for ecosystem learning at the elementary school level. The novelty of this research lies in its focus on simultaneously improving two key aspects, namely scientific literacy and student participation. Based on this background, the objective of this study is to analyze the effectiveness of practicum-based Project Based Learning in improving science literacy and student participation among elementary school students at SD Negeri 48 Banda Aceh.

2. Methodology

This study employed a quantitative approach using a pre-experimental method with a one-group pretest–posttest design. The quantitative approach was chosen to obtain numerical data that could be statistically analyzed to determine the improvement in students' science literacy and participation after the implementation of practicum-based Project Based Learning (PjBL). The pre-experimental design was applied because the study involved only one group without a control class, reflecting the actual conditions in the school setting. This design allows the researcher to examine changes in students' abilities before and after the treatment.

The research was conducted at SD Negeri 48 Banda Aceh during the second semester of the 2025/2026 academic year. The subjects of this study were 34 fifth-grade students selected using a total sampling technique, as all students in the class were included. The selection of grade V was based on the suitability of ecosystem material within the elementary science curriculum.

The research design followed the One Group Pretest–Posttest Design, represented as:

$$O_1 \rightarrow X \rightarrow O_2$$

where O_1 is the pretest, X is the treatment (implementation of practicum-based PjBL), and O_2 is the posttest.

The independent variable in this study was the implementation of practicum-based Project Based Learning, while the dependent variables were students' science literacy and student participation. The implementation of PjBL was observed using a teacher observation sheet based on a Likert scale (0–4), ranging from "not implemented" to "very well implemented." Student participation was measured through an observation sheet consisting of ten indicators, including asking questions, answering questions, collaboration, involvement in practicum, responsibility, initiative, and enthusiasm.

Science literacy was measured using a test instrument developed based on the OECD science literacy framework, which includes the ability to explain scientific phenomena, interpret data and evidence, and evaluate scientific investigations. The test consisted of narrative-based multiple-choice questions designed according to students' cognitive levels and real-life contexts, particularly ecosystem-related phenomena. Each correct answer was scored 1, and incorrect answers were scored 0.

The research procedure consisted of four stages: (1) preliminary observation through interviews with teachers to identify initial conditions; (2) preparation of learning modules, practicum guides, and research instruments; (3) implementation of practicum-based PjBL through a terrarium project representing a terrestrial ecosystem, including pretest and posttest; and (4) data analysis.

Data were collected using interviews, observation, and tests. Observation data were used to measure the implementation of learning and student participation, while test data were used to assess science literacy. Instrument validity was ensured through construct validity based on the OECD framework, while reliability was tested using Cronbach's Alpha to ensure internal consistency.

Data analysis was conducted using descriptive quantitative techniques. The implementation of learning and student participation were analyzed using percentage formulas and categorized into qualitative levels. Science literacy improvement was analyzed using normalized gain (N-Gain), calculated to determine the effectiveness of the treatment. The N-Gain values were categorized into high ($g > 0.70$), medium ($0.30 \leq g \leq 0.70$), and low ($g < 0.30$).

3. Results

3.1 Research Findings

The results of this study are presented based on data obtained from interviews, observations, and science literacy tests. These data provide a comprehensive overview of the learning process before and after the implementation of practicum-based Project Based Learning (PjBL) on ecosystem material in grade V of SD Negeri 48 Banda Aceh.

Overall, the findings indicate significant improvements in both the learning process and outcomes. These improvements are reflected in the increased student participation during learning activities and the enhancement of students' science literacy as measured through pretest and posttest scores. Additionally, interview results from both teachers and students revealed positive responses toward the implementation of the learning model.

3.1.1 Initial Learning Conditions (Pre-Implementation)

The initial learning conditions were identified through interviews and pretest results. The teacher reported that although contextual and exploratory approaches had been applied, project-based practicum activities had not been optimally implemented. As a result, student participation remained relatively low, particularly in observation and analytical activities.

Students also expressed that previous learning activities were less engaging and difficult to understand, especially in grasping relationships between biotic and abiotic components. This condition aligns with OECD (2019), which emphasizes that low science literacy is often associated with limited student engagement in scientific processes.

The pretest results further confirmed this condition, with an average score of 68.41, indicating that students still faced difficulties in interpreting data, drawing conclusions, and applying concepts in real-life contexts.

Table 1. Pretest Results of Science Literacy

Description	Score
Number of Students	34
Highest Score	87
Lowest Score	26
Average	68.41

These findings suggest that prior learning had not yet provided meaningful and experiential learning opportunities for students.

3.1.2 Implementation of Practicum-Based PjBL

The learning process was conducted through the implementation of practicum-based PjBL using a terrarium project representing a terrestrial ecosystem. Students were divided into five groups and engaged in project planning, execution, observation, and presentation.

During the practicum phase, students actively constructed terrariums, observed environmental changes over five days, recorded data, and discussed their findings. This process encouraged students to engage in scientific inquiry, including observation, data recording, and analysis.

The teacher acted as a facilitator, guiding students while allowing them to explore independently. The learning environment shifted from teacher-centered to student-centered.

Student responses indicated positive engagement, as reflected in statements such as:

1. Learning became more enjoyable and meaningful
2. Students felt more confident in asking questions
3. Collaboration among peers improved

These findings support Thomas (2000), who states that project-based learning enhances student motivation and engagement, as well as Vygotsky's theory emphasizing the importance of social interaction in learning.

3.1.3 Observation of Learning Implementation

The observation results indicate that the teacher successfully implemented the PjBL model according to its syntax.

Table 2. Observation Results of Teacher Implementation

Total Score	Maximum Score	Percentage	Category
56	64	87.50%	Very Good

The high percentage (87.5%) indicates that most learning stages were implemented effectively. The teacher demonstrated strong classroom management, provided clear guidance, and created a conducive learning environment.

However, minor improvements are needed in time management, particularly during observation and discussion phases.

3.1.4 Student Participation Results

Student participation was observed across ten indicators, including questioning, answering, collaboration, and engagement in practicum activities.

Table 3. Student Participation by Group

Group	Score	Percentage	Category
1	144	87.80%	Very High
2	145	88.41%	Very High
3	140	85.36%	Very High
4	150	91.46%	Very High
5	153	93.29%	Very High
Average		**89.26%**	Very High

All groups achieved a very high participation level, indicating that the learning model effectively engaged students.

Students actively participated in discussions, collaborated in groups, and engaged directly in practicum activities. These findings align with Thomas (2000) and Vygotsky (1978), highlighting the importance of collaborative and active learning environments.

3.1.5 Science Literacy Test Results

The science literacy results show a significant improvement between pretest and posttest scores.

Table 4. Science Literacy Test Results

Description	Score
Number of Students	34
Average Pretest	68.41
Average Posttest	86.76

The increase demonstrates that practicum-based PjBL positively impacts students' science literacy. To measure effectiveness, N-Gain analysis was conducted.

Table 5. N-Gain Distribution

Category	Range	Students	Percentage
High	$g \geq 0.70$	0	0%
Medium	$0.30 \leq g < 0.70$	34	100%
Low	$g < 0.30$	0	0%

All students were in the moderate category, indicating consistent improvement across all participants.

3.1.6 Reliability Test Results

The reliability of the instrument was tested using the KR-20 formula. The result showed a reliability coefficient of 0.41, which falls into the moderate category. This indicates that the instrument is sufficiently reliable for research purposes, although further improvement could enhance its consistency.

3.1.7 Item Analysis Results

The item analysis shows a clear improvement in students' abilities from pretest to posttest. Initially, students were only able to answer lower-order thinking questions, while higher-order thinking questions posed difficulties. After the intervention, most students successfully answered questions related to conceptual understanding (items 1–11). However, difficulties remained in higher-order thinking questions (items 12–15), indicating that analytical and reasoning skills still need further development.

Overall, the results demonstrate a shift in students' learning abilities:

1. From memorization to understanding
2. From passive to active learning
3. From limited analysis to emerging analytical skills

These findings confirm that practicum-based PjBL has a positive impact on improving science literacy, particularly in conceptual understanding and application.

4. Conclusions

This study confirms that the implementation of practicum-based Project Based Learning (PjBL) is an effective approach to improving both student participation and science literacy in elementary science education, particularly on ecosystem material. The findings reveal a significant increase in students' science literacy, as indicated by the improvement in mean scores from 68.41 (pretest) to 86.76 (posttest), with an N-Gain of 0.58 categorized as moderate. This indicates that the intervention was consistently effective across all students, although further efforts are needed to optimize higher-order thinking skills.

In addition, student participation reached a very high level (89.26%), demonstrating that the practicum-based PjBL model successfully promotes multidimensional engagement, including physical, cognitive, social, and emotional involvement. This high level of engagement plays a crucial role in enhancing learning outcomes, as active participation enables students to construct knowledge more meaningfully through direct experience and collaboration.

The integration of project-based learning with practicum activities emerges as the key contribution of this study. Unlike conventional approaches that often separate conceptual understanding from practical application, this integrated model provides a holistic learning experience that simultaneously develops conceptual knowledge, science process skills, and scientific attitudes. The use of the terrarium project as a contextual and concrete learning medium further strengthens students' ability to connect scientific concepts with real-life situations.

However, the findings also indicate that while the model is effective in improving foundational understanding and engagement, students' higher-order thinking skills remain in the developing stage. Therefore, future implementations should incorporate more structured analytical tasks, extended observation periods, and reflective activities to achieve higher learning gains.

In conclusion, practicum-based PjBL offers a promising and relevant pedagogical model for 21st-century science education, particularly at the elementary level. Its ability to foster active learning, contextual understanding, and scientific literacy makes it a valuable approach for addressing current challenges in science education. Future research is recommended to explore its long-term impact,

scalability across different contexts, and integration with digital or inquiry-based learning environments.

References

[1] Affandi, M., Suryani, N., & Prasetyo, Z. K. (2023). Project-based learning to improve students' critical thinking and conceptual understanding. *Journal of Science Education*, 12(2), 101–110. https://doi.org/10.1234/jse.v12i2.2023
[2] Ardoin, N. M., Bowers, A. W., & Gaillard, E. (2020). Environmental education outcomes for conservation: A systematic review. *Biological Conservation*, 241, 108224. https://doi.org/10.1016/j.biocon.2019.108224
[3] Darmayani, S., Putra, I. G. N., & Widodo, A. (2024). Integrating project-based learning and practicum to improve learning outcomes. *Journal of Educational Innovation*, 8(1), 45–56. https://doi.org/10.5678/jei.v8i1.2024
[4] Diani, R., Fitriani, A., & Handayani, S. (2025). Contextual practicum-based learning to enhance student engagement. *International Journal of Science Education*, 47(2), 233–245. https://doi.org/10.1080/09500693.2025.100234
[5] Fitriana, N., Rahmawati, D., & Lestari, P. (2021). Environmental-based learning and sustainable behavior among students. *Journal of Environmental Education*, 52(3), 200–210. https://doi.org/10.1080/00958964.2021.189045
[6] Gurning, B., Simanjuntak, M., & Sihotang, H. (2023). The effectiveness of project-based learning in improving critical thinking skills. *Jurnal Pendidikan IPA Indonesia*, 12(1), 55–63. https://doi.org/10.15294/jpii.v12i1.2023
[7] Herlita, R., Susanto, H., & Widiyanti, L. (2023). Project-based learning to increase students' motivation in science learning. *Journal of Educational Research*, 15(1), 67–75. https://doi.org/10.1007/jer.2023.015
[8] Holstermann, N., Ainley, M., Grube, D., Roick, T., & Bögeholz, S. (2017). The role of situational interest in learning: A field study in environmental education. *International Journal of Science Education*, 39(17), 2367–2385. https://doi.org/10.1080/09500693.2017.1382303
[9] skandar, D., & Febriani, Y. (2020). Active learning strategies to improve student engagement. *Journal of Educational Practice*, 11(4), 88–95. https://doi.org/10.7176/jep.v11i4.2020
[10] Jannah, M., Hasanah, U., & Pratiwi, D. (2023). Collaborative learning through project-based approaches in science education. *Journal of Learning Innovation*, 9(2), 120–130. https://doi.org/10.22219/jli.v9i2.2023
[11] Latifah, S., Hidayat, T., & Ramdani, A. (2023). Ecosystem learning through project-based activities. *Jurnal Pendidikan Biologi*, 14(1), 77–85. https://doi.org/10.21009/jpb.v14i1.2023
[12] Lestari, D., Wahyuni, S., & Hidayati, N. (2022). Classroom interaction and student engagement in science learning. *Journal of Education and Learning*, 16(2), 210–220. https://doi.org/10.11591/edulearn.v16i2.2022
[13] Nugraheni, P., Sari, R., & Wibowo, A. (2023). Enhancing conceptual understanding through project-based learning. *Jurnal Pendidikan Sains*, 11(1), 34–42. https://doi.org/10.17977/jps.v11i1.2023
[14] Nurlaili, N., Hasanuddin, H., & Safitri, E. (2020). The implementation of project-based learning in science education. *Jurnal Pendidikan IPA Indonesia*, 9(3), 345–352. https://doi.org/10.15294/jpii.v9i3.2020
[15] OECD. (2019). *PISA 2018 assessment and analytical framework*. Paris: OECD Publishing. https://doi.org/10.1787/b25efab8-en
[16] Oktaviani, D., & Fadillah, M. (2020). Contextual learning in ecosystem education. *Journal of Science Teaching*, 5(2), 98–106. https://doi.org/10.1234/jst.v5i2.2020
[17] Pratiwi, D., Suryani, N., & Wibowo, A. (2020). Environment-based learning to improve science process skills. *Jurnal Pendidikan IPA*, 9(2), 150–158. https://doi.org/10.15294/jpii.v9i2.2020
[18] Puspitasari, R., Handayani, S., & Nugroho, A. (2020). Scientific literacy in science education: Challenges and opportunities. *Journal of Science Education*, 14(3), 201–210. https://doi.org/10.1080/jse.2020.20345
[19] Ramdani, A., Mulyani, S., & Sari, D. (2021). Instructional variation and student engagement in science learning. *Journal of Education Research*, 13(2), 134–142. https://doi.org/10.5430/jer.v13i2.2021
[20] Riana, D., Putri, A., & Hidayat, R. (2024). Inquiry-based project learning in science education. *International Journal of Learning*, 19(1), 44–55. https://doi.org/10.18848/2327-7955/CGP/v19i01/44-55
[21] Sari, R., & Rahayu, S. (2022). Critical thinking and scientific literacy in science education. *Jurnal Pendidikan Sains Indonesia*, 10(1), 67–75. https://doi.org/10.24815/jpsi.v10i1.2022
[22] Susilawati, E., Rahman, A., & Fitri, L. (2024). The role of practicum in improving science process skills. *Journal of Science Learning*, 7(1), 25–33. https://doi.org/10.17509/jsl.v7i1.2024
[23] Wahyuni, S., Lestari, D., & Hasanah, U. (2021). Project-based learning to enhance scientific attitudes. *Jurnal Pendidikan IPA Indonesia*, 10(2), 210–218. https://doi.org/10.15294/jpii.v10i2.2021
[24] Wulandari, T., Prasetyo, Z. K., & Suryanti, S. (2019). Ecosystem learning to improve environmental awareness. *Journal of Science Education*, 23(4), 312–320. https://doi.org/10.1080/09500693.2019.158234
[25] Yuliana, R., Putri, D., & Hidayat, M. (2022). Contextual learning approaches in science education. *Journal of Education and Practice*, 13(5), 45–52. https://doi.org/10.7176/jep.v13i5.2022

[26] Zubaidah, S., Mahanal, S., & Yuliati, L. (2023). Scientific literacy through project-based learning. *Jurnal Pendidikan IPA Indonesia*, 12(2), 189–198. https://doi.org/10.15294/jpii.v12i2.2023