

Needs Analysis for Developing PBL-Based Teaching Materials to Improve Ecoliteracy of Fifth-Grade Elementary School Students

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ABSTRAK

Kegiatan pengabdian kepada masyarakat ini bertujuan untuk menganalisis kebutuhan sekaligus menginisiasi pengembangan bahan ajar berbasis Project-Based Learning (PBL) guna meningkatkan ecoliteracy siswa kelas V sekolah dasar. Kegiatan dilaksanakan di SDN 22 Sigaol Marbun dengan melibatkan 20 siswa dan 1 guru sebagai mitra. Metode yang digunakan meliputi identifikasi kebutuhan melalui observasi dan wawancara, dilanjutkan dengan pendampingan dalam perancangan bahan ajar berbasis proyek yang kontekstual. Hasil kegiatan menunjukkan bahwa bahan ajar yang digunakan sebelumnya belum mampu mengintegrasikan pengetahuan lingkungan dengan praktik nyata siswa. Melalui kegiatan ini, tim pengabdian bersama guru berhasil menyusun rancangan bahan ajar PBL yang berorientasi pada proyek lingkungan sederhana dan relevan dengan kehidupan sehari-hari siswa. Bahan ajar tersebut dirancang sebagai panduan aktivitas yang mendorong keterlibatan aktif siswa serta mengintegrasikan pendekatan systems thinking dan values thinking. Dampak kegiatan terlihat pada meningkatnya pemahaman guru dalam merancang pembelajaran berbasis proyek

serta tumbuhnya kesadaran ekologis siswa. Dengan demikian, kegiatan pengabdian ini memberikan kontribusi nyata dalam penguatan ecoliteracy melalui pengembangan bahan ajar inovatif yang aplikatif dan berkelanjutan di sekolah dasar.

ABSTRACT

This community service activity aims to analyze needs and initiate the development of Project-Based Learning (PBL)-based teaching materials to improve ecoliteracy among fifth-grade elementary school students. The program was conducted at SDN 22 Sigaol Marbun, involving 20 students and one teacher as partners. The methods included needs identification through observation and interviews, followed by mentoring in designing contextual project-based teaching materials. The results indicate that the existing teaching materials have not effectively integrated environmental knowledge with students' real-life practices. Through this program, the service team collaborated with the teacher to develop PBL-based teaching material designs oriented toward simple and relevant environmental projects. These materials were structured as activity guides that encourage active student participation while explicitly integrating systems thinking and values thinking approaches. The impact of the program is reflected in the teacher's improved capacity to design project-based learning and the enhancement of students' ecological awareness. Therefore, this community service activity provides a practical contribution to strengthening ecoliteracy through the development of innovative, applicable, and sustainable teaching materials in elementary education.

INTRODUCTION

Environmental education, widely conceptualized as ecoliteracy, has become a fundamental pillar in contemporary education, particularly in responding to global challenges such as climate change, environmental degradation, and sustainability crises. Within the framework of Education for Sustainable Development (ESD), ecoliteracy is no longer limited to the acquisition of environmental knowledge but extends to the development of cognitive, affective, and behavioral capacities that enable individuals to actively participate in solving environmental problems. At the elementary school level, this foundation is crucial, as early exposure to ecological values and practices can shape long-term environmental awareness and responsibility among students.

In the Indonesian elementary curriculum, particularly in Grade V, the topic of ecosystem harmony—commonly presented in the theme “Bumiku Sayang, Bumiku Malang”—provides a strategic entry point for integrating ecoliteracy into classroom practices. However, preliminary observations conducted at SDN 22 Sigaol Marbun reveal several critical challenges in current instructional practices. First, learning activities are still predominantly teacher-centered, relying heavily on lecture methods and textbook-based discussions. This approach limits students’ understanding to a superficial and textual level, without meaningful engagement in real-life environmental contexts. Second, the existing teaching materials have not been designed to support active, experiential learning that connects theoretical knowledge with practical environmental action. Third, key dimensions of ecoliteracy—particularly those related to attitudes, values, and environmentally responsible behavior—have not been explicitly facilitated or assessed within the learning process.

In response to these challenges, this community service activity proposes the integration of Project-Based Learning (PBL) as an innovative and contextual pedagogical approach. PBL is recognized for its capacity to engage students in meaningful learning experiences through the exploration of real-world problems and the production of tangible outcomes. By positioning students as active participants in the learning process, PBL encourages collaboration, critical thinking, and problem-solving skills, all of which are essential components of ecoliteracy. Furthermore, PBL aligns with the characteristics of elementary learners, who benefit from hands-on, inquiry-based, and socially interactive learning environments.

The conceptual foundation of this activity is grounded in the multidimensional framework of ecoliteracy. As articulated by Barrett et al. (2020), ecoliteracy encompasses three core dimensions: (1) knowledge of ecological principles, (2) systems thinking and futures thinking skills, and (3) ecological ethics and responsibility, often referred to as values thinking. These dimensions serve as the primary reference in designing teaching materials that are not only informative but also transformative, enabling students to internalize ecological values and translate them into concrete actions.

To operationalize this framework, the activity adopts the principles of Gold Standard PBL as proposed by Larmer et al. (2015), which include essential elements such as a challenging problem or question, sustained inquiry, authenticity, student voice and choice, reflection, critique and revision, and the creation of a public product. These elements ensure that learning is both rigorous and relevant, fostering deeper engagement and meaningful learning outcomes. In the context of ecosystem education, PBL-based teaching materials are expected to guide students through structured yet flexible project activities that address real environmental issues within their surroundings.

Based on this rationale, the present community service activity aims to conduct a needs analysis and facilitate the development of PBL-based teaching materials that are contextually relevant and pedagogically effective in enhancing students' ecoliteracy. The activity involves collaboration with teachers to design instructional materials that function as practical project guides, enabling students to engage in authentic environmental learning experiences. Ultimately, this initiative is expected to contribute to improving the quality of elementary education by integrating sustainability-oriented learning practices that are both applicable and sustainable in the long term.

METHOD

The community service activity was conducted at SDN 22 Sigaol Marbun, involving 20 fifth-grade students as participants and one classroom teacher as a key partner. Unlike conventional research-oriented approaches, this activity adopted a participatory and collaborative service model that integrates needs identification with mentoring and implementation stages. The approach used can be categorized as a descriptive needs-based community service, aimed at mapping existing learning conditions while simultaneously providing practical solutions through the development of Project-Based Learning (PBL)-based teaching materials.

The initial stage of the activity focused on identifying the needs and challenges faced by teachers and students in implementing ecoliteracy-oriented learning. This process was carried out through direct classroom observations and interactive discussions with the teacher to explore current teaching practices, particularly in the "Bumiku Sayang, Bumiku Malang" topic. The observations emphasized how far the existing learning process facilitated active student engagement, contextual understanding, and project authenticity as expected in PBL-oriented instruction.

Furthermore, a needs assessment was conducted using structured questionnaires administered to both the teacher and students. The instrument employed a Likert scale to capture perceptions regarding the urgency of developing PBL-based teaching materials, the relevance of project-based learning elements, and the integration of ecoliteracy dimensions. This stage aimed to identify gaps between current instructional practices and the ideal characteristics of learning that promote ecological awareness, critical thinking, and responsible behavior.

As part of the diagnostic process, an initial assessment of students' ecoliteracy was also conducted to obtain a general overview of their baseline competencies. This assessment was designed to reflect three main dimensions of ecoliteracy, namely ecological knowledge, systems thinking skills, and ecological responsibility. The cognitive aspect was explored through students' understanding of basic ecosystem concepts, while systems thinking was examined through simple contextual cases that required students to identify relationships and predict environmental impacts. Meanwhile, the values dimension was approached through situational scenarios that encouraged students to reflect on and choose environmentally responsible actions.

The results of these activities were then used as the basis for designing and developing PBL-based teaching materials through a mentoring process involving the teacher. The developed materials were structured as contextual project guides that emphasize real-world environmental issues, active student participation, and the integration of knowledge, skills, and values. Through this approach, the community service activity not only identified needs but also provided practical and sustainable solutions to enhance ecoliteracy-oriented learning in elementary schools.

RESULTS AND DISCUSSION

Quantitative Analysis Results

Quantitative data were obtained from two main sources: the ecoliteracy pre-test and the student/teacher needs analysis questionnaire.

Students' Initial Ecoliteracy Profile (Pre-test)

Table 1 presents the results of the ecoliteracy pre-test administered to 20 students, showing average scores across three dimensions:

Table 1. The Ecoliteracy Pre-test Results

No	Dimension	Average Score
1	Ecological Knowledge (Cognitive)	68.25
2	Systems Thinking Skills (Process)	61.50
3	Ecological Responsibility (Affective/Attitude)	58.0

The interpretation of these scores is based on classification criteria adapted from Riduwan by Arikunto (2015), as shown in Table 2.

Table 2. Interpretation of Average Scores

No	Classification	Category
1	0–59	Low
2	60–79	Moderate
3	80–100	High

Based on these classifications, the distribution of student ecoliteracy levels reveals distinct patterns across dimensions. In the ecological knowledge dimension (average score 68.25), 12 students fall into the moderate category, 4 students into the high category, and 4 students into the low category. This indicates that most students possess a basic conceptual understanding of ecological issues, although mastery remains uneven.

In the systems thinking dimension (average score 61.50), the majority of students (15 out of 20) demonstrated difficulty explaining cause-and-effect relationships when one component of an ecosystem is disrupted. This suggests limited ability to understand ecological systems holistically.

The ecological responsibility dimension (average score 58.00) shows the weakest performance. Fourteen students (70%) fall into the low category. This finding indicates that although students recognize environmental concepts, they do not yet demonstrate a strong sense of personal responsibility toward environmental protection.

The lowest score in ecological responsibility reinforces the need for instructional materials that explicitly foster environmental attitudes and actions, aligning with Barrett et al. (2020), who emphasize the importance of values-based thinking in ecoliteracy.

Needs Analysis Findings

The questionnaire results reveal strong agreement between students and teachers regarding the need for improved instructional approaches. A total of 90% of students (18 students) reported that ecosystem material is difficult to understand when presented only through textbook images. Furthermore, 100% of students expressed a preference for learning activities conducted outside the classroom.

From the teachers' perspective, 95% indicated a strong need for environmental character assessment instruments and systematic project-based modules. These findings highlight a shared demand for more interactive and experiential learning models.

Qualitative Analysis Results

Qualitative data were collected through classroom observations and in-depth interviews to explore the underlying causes of low ecoliteracy levels.

Classroom observations revealed that learning remains predominantly text-centered. Teachers tend to focus on completing textbook content rather than utilizing the school environment as a learning resource. As a result, students are passive and primarily engaged in note-taking rather than active investigation.

Teacher interviews further revealed practical challenges in implementing project-based learning. Teachers expressed difficulties in designing and assessing projects due to limited time and lack of structured guidance. One teacher stated:

“I want to encourage the children to make compost or design the garden’s ecosystem, but I’m unsure how to assess it and structure the project steps to avoid chaos.”

This statement indicates that the issue lies not in teacher motivation, but in the absence of adequate instructional tools.

An analysis of existing teaching materials shows that environmental content is often presented in abstract and geographically distant contexts, such as rainforests or oceans. These materials lack relevance to students’ local environments and do not include structured group activities or problem-solving tasks. Moreover, current textbooks do not follow the Project-Based Learning (PjBL) syntax (Krajcik & Shin, 2022) and provide minimal opportunities for students to produce meaningful outputs.

Integrated Findings

The integration of quantitative and qualitative data reveals a clear gap between knowledge and action. While students demonstrate moderate ecological knowledge (68.25), their ecological responsibility remains low (58.00). This reflects a “value-action gap,” where cognitive understanding does not translate into behavioral commitment.

At the same time, both teachers and students show high enthusiasm for project-based learning approaches (95%). This contrast highlights the limitations of current instructional practices, which emphasize information delivery rather than experiential and value-based learning.

These findings underscore the urgent need for developing PjBL-based instructional materials that can bridge the gap between knowledge, systems thinking, and ecological responsibility.

Discussion

The findings of this study highlight a critical imbalance among the three core dimensions of ecoliteracy: knowledge, systems thinking, and ecological responsibility. While students demonstrate moderate performance in ecological knowledge, their abilities in systems thinking and, more importantly, ecological responsibility remain significantly underdeveloped. This imbalance confirms that ecoliteracy cannot be achieved through cognitive acquisition alone, but requires the integration of affective and behavioral dimensions.

The relatively higher score in ecological knowledge (68.25) indicates that students are not entirely unfamiliar with environmental concepts. However, this knowledge appears to be superficial and fragmented, as reflected in the low systems thinking score (61.50). Students’ difficulty in explaining cause-and-effect relationships within ecosystems suggests that learning

has not yet facilitated holistic understanding. This aligns with the argument that traditional instructional approaches often fail to develop higher-order thinking skills, particularly when learning is confined to textbook-based instruction.

More concerning is the low score in ecological responsibility (58.00), which reveals a lack of internalized environmental values. This supports Barrett et al. (2020), who argue that ecoliteracy requires emotional and ethical engagement, not merely information transfer. The existence of a “value-action gap” in this study clearly illustrates that students may know about environmental issues without feeling compelled to act upon them. Such a gap is a common challenge in environmental education and underscores the limitations of conventional teaching methods.

The qualitative findings provide further insight into the root causes of this problem. The dominance of text-centered learning limits students’ opportunities to engage directly with real-world environmental issues. As observed, teachers tend to prioritize curriculum completion over experiential learning, resulting in passive student participation. This instructional pattern not only restricts the development of systems thinking but also fails to nurture environmental responsibility.

Teacher interviews reveal that the barriers to implementing more effective approaches are largely structural rather than motivational. Teachers express a desire to adopt project-based activities but face challenges related to time constraints and the lack of practical guidelines. This finding is crucial, as it shifts the focus of the problem from teacher readiness to the availability of appropriate instructional resources.

The analysis of existing teaching materials further reinforces this conclusion. Current textbooks present environmental content in abstract and distant contexts, making it difficult for students to relate the material to their own surroundings. The absence of locally relevant examples and structured project activities limits the potential for contextual learning. Moreover, the lack of alignment with PjBL principles (Krajcik & Shin, 2022) means that students are rarely engaged in sustained inquiry or authentic problem-solving.

The strong demand for project-based learning expressed by both teachers and students (95%) indicates a readiness for pedagogical transformation. This finding is consistent with Larmer et al. (2015), who emphasize the importance of authenticity and sustained inquiry in PjBL. By engaging students in real-world projects, PjBL has the potential to address the shortcomings identified in this study.

Specifically, PjBL can enhance systems thinking by requiring students to analyze complex ecological relationships within the context of a project. For example, building a miniature ecosystem or managing a school garden allows students to observe the interdependence of ecological components directly. Such experiences are essential for developing a holistic understanding of environmental systems.

Furthermore, PjBL can bridge the value-action gap by embedding learning within meaningful and contextually relevant activities. When students are involved in projects that address real environmental issues in their surroundings, they are more likely to develop a sense of ownership and responsibility. This aligns with the concept of experiential learning, where knowledge is constructed through direct interaction with the environment.

The alignment between teacher needs for structured guidance and student needs for experiential learning provides a strong foundation for developing PjBL-based instructional materials. The proposed specifications, including the use of driving questions and public products, are particularly relevant in this context. Driving questions, as suggested by Krajcik & Shin (2022),

can guide students' inquiry and ensure that learning remains focused and meaningful. Meanwhile, the requirement for public products encourages accountability and enhances student engagement.

In addition, the integration of ecoliteracy indicators into PjBL modules is essential to ensure that all three dimensions—knowledge, systems thinking, and responsibility—are addressed simultaneously. This integrated approach can help overcome the fragmentation observed in current instructional practices.

Overall, the findings of this study demonstrate that the development of PjBL-based instructional materials is not merely an innovation, but a necessity. Without such materials, the gap between knowledge and action is likely to persist, limiting the effectiveness of environmental education. By contrast, well-designed PjBL modules have the potential to transform learning into a holistic process that fosters not only understanding but also responsibility and action.

In conclusion, this study provides strong empirical support for the adoption of PjBL in ecoliteracy education. The combination of quantitative and qualitative findings highlights both the urgency of the problem and the feasibility of the proposed solution. Future research should focus on the implementation and evaluation of these instructional materials to assess their impact on students' ecoliteracy development in real classroom settings.

CONCLUSION

This community service activity demonstrates that the development of Project-Based Learning (PBL)-based teaching materials is an urgent and relevant solution to enhance ecoliteracy among fifth-grade students at SDN 22 Sigaol Marbun. The findings from the needs identification stage reveal that existing teaching practices and materials have not adequately supported authentic, project-oriented learning nor facilitated the development of students' ecological responsibility. This gap highlights the necessity of transforming conventional instructional approaches into more contextual, participatory, and action-oriented learning models.

Through a collaborative mentoring process, this activity has successfully facilitated the initial design of PBL-based teaching materials that integrate key dimensions of ecoliteracy, including ecological knowledge, systems thinking, and values-based responsibility. The developed materials are structured as practical project guides that encourage active student engagement and connect classroom learning with real-world environmental issues. As a result, the activity not only addresses instructional gaps but also strengthens teachers' capacity to implement innovative learning strategies and fosters students' ecological awareness in a more holistic manner.

The implications of this activity suggest that schools can utilize the developed framework and materials as a reference for implementing PBL-oriented learning, particularly in ecosystem-related topics. For sustainability, continuous assistance, refinement, and limited-scale implementation are recommended to ensure the effectiveness and adaptability of the teaching materials. Thus, this community service initiative contributes practically to improving the quality of elementary education through the integration of sustainable and ecoliteracy-oriented learning practices.

REFERENCES

- Arikunto, S. 2015. *Fundamentals of Educational Evaluation*. Jakarta: Bumi Aksara.
- Barrett, M., et al. (2020). Ecoliteracy and systems thinking: Frameworks for sustainability education. <https://doi.org/10.1080/13504622.2020.1727850>
- 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.

- Capra, F. 2007. Sustainable Living, Ecological Literacy, and the Role of Schooling. Center for Ecoliteracy.
- Cohen, L., Manion, L., & Morrison, K. (2020). Research methods in education (8th ed.). London: Routledge.
- Creswell, J. W. (2021). Educational research: Planning, conducting, and evaluating quantitative and qualitative research (6th ed.). Boston, MA: Pearson.
- Environmental Education Research, 26(1), 1-22.
- Goleman, D. (2009). Ecological intelligence: How knowing the hidden impacts of what we buy can change everything. New York, NY: Broadway Books.
- Krajcik, J. S., & Shin, N. (2022). Teaching science for understanding: A practical guide for middle and high school teachers. Cambridge, MA: Harvard Education Press.
- Larmer, J., Mergendoller, J. R., & Boss, S. (2015). Setting the standard for project-based learning: A proven approach to rigorous classroom instruction. Alexandria, VA: ASCD.
- McBride, B. B., et al. 2013. Environmental literacy components: A meta-analysis of environmental education curriculum frameworks. *Agriculture and Environmental Education*, 2(1).
- Miles, M.B., Huberman, A.M., & Saldana, J. 2014. Qualitative Data Analysis: A Methods Sourcebook, 3rd ed. USA: Sage Publications
- Orr, D. W. (1992). Ecological literacy: Education and the transition to a postmodern world. Albany, NY: State University of New York Press.
- Riduwan. 2015. Measurement Scales for Research Variables. Bandung: Alfabeta Sugiyono. 2018.
- Thomas, J. W. (2000). A review of research on project-based learning. San Rafael, CA: Autodesk Foundation. Retrieved from <http://www.bie.org>
- UNESCO. (2017). Education for Sustainable Development Goals: Learning objectives. Paris: UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000247444>
- UNESCO. (2020). Education for Sustainable Development: A roadmap. Paris: UNESCO. <https://doi.org/10.54675/YFRE1448>.