



Fostering Pre-Service Elementary Education Teachers' Environmental Literacy Through Ecobrick Project Assistance

Zahratul Idami^{1*}, Dessy Kurniasy², Fadhillah Wiandari³, Chery Julida Panjaitan⁴

^{1*,2,3,4}Institut Agama Islam Negeri Langsa, Kota Langsa, Indonesia

E-mail: zahra@iainlangsa.ac.id

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Abstract

Environmental literacy is an essential competency for pre-service teachers, who play a strategic role in promoting sustainable practices in future classrooms. This community service project aimed to foster environmental literacy among pre-service elementary education teachers through an ecobrick assistance program using the Community-Based Research (CBR) approach. The program involved 60 students from the Elementary Teacher Education Department of IAIN Langsa, and was conducted over four weeks. The program comprised four stages: (1) collaborative planning and needs assessment, (2) ecobrick training and project design, (3) project implementation and continuous assistance, and (4) product presentation, reflection, and evaluation. Data were collected through environmental literacy questionnaires and product assessments and analysed using descriptive statistics. The findings indicated progresses in participants' environmental knowledge, pro-environmental attitudes, and waste management practices. All groups successfully produced functional ecobrick products from plastic waste, demonstrating their ability to apply sustainability concepts in practice. The CBR approach also promoted active participation, shared responsibility, and contextual learning throughout the project. This project contributes to teacher education by demonstrating a practical and replicable model for integrating environmental education, project-based learning, and community engagement while supporting sustainable plastic waste management in higher education.

Abstrak

Literasi lingkungan merupakan kompetensi penting bagi calon guru karena mereka memiliki peran strategis dalam mendorong praktik berkelanjutan di lingkungan pembelajaran. Kegiatan pengabdian kepada masyarakat ini bertujuan untuk meningkatkan literasi lingkungan calon guru sekolah dasar melalui program pendampingan pembuatan ecobrick dengan pendekatan *Community-Based Research* (CBR). Program ini melibatkan 60 mahasiswa Program Studi Pendidikan Guru Sekolah Dasar IAIN Langsa, Indonesia, dan dilaksanakan selama empat minggu. Program terdiri atas empat tahap, yaitu (1) perencanaan kolaboratif dan identifikasi kebutuhan, (2) pelatihan *Ecobrick* dan perancangan proyek, (3) pelaksanaan



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proyek dan pendampingan berkelanjutan, serta (4) presentasi produk, refleksi, dan evaluasi. Data dikumpulkan melalui kuesioner literasi lingkungan dan penilaian produk, kemudian dianalisis menggunakan statistik deskriptif. Hasil menunjukkan adanya peningkatan pengetahuan lingkungan, sikap pro-lingkungan, dan praktik pengelolaan sampah peserta. Seluruh kelompok berhasil menghasilkan produk *Ecobrick* yang fungsional dari limbah plastik, menunjukkan kemampuan peserta dalam menerapkan konsep keberlanjutan secara praktis. Pendekatan CBR juga mendorong partisipasi aktif, tanggung jawab bersama, dan pembelajaran kontekstual selama pelaksanaan program. Kegiatan ini berkontribusi pada pendidikan calon guru melalui model yang praktis dan dapat direplikasi untuk mengintegrasikan pendidikan lingkungan, pembelajaran berbasis proyek, dan keterlibatan masyarakat sekaligus mendukung pengelolaan sampah plastik berkelanjutan di perguruan tinggi.

Introduction

Environmental problems caused by plastic waste have become one of the most pressing global challenges (Kibria et al., 2023). The increasing consumption of single-use plastics has contributed to environmental pollution, ecosystem degradation, and threats to human health (Abahussain et al., 2025). Higher education institutions have an important responsibility to address this issue by promoting environmental awareness and sustainable behaviors among students. For pre-service elementary education teachers, environmental education is particularly significant because they will become future educators who influence children's attitudes and behaviors toward the environment. Therefore, developing environmental literacy during teacher education is a strategic effort to support sustainable development and create environmentally responsible communities.

In this context, Kaya & Elster (2019) mention that environmental literacy refers to an individual's ability to understand environmental issues, develop positive attitudes toward nature, and make informed decisions that contribute to environmental sustainability. Environmental literacy also encompasses several interconnected dimensions, including environmental knowledge, environmental attitudes, cognitive skills, and responsible environmental behaviors (Xiong et al., 2025). In the context of teacher education, environmental literacy is not only about understanding ecological concepts but also about applying environmentally friendly practices in everyday life and integrating sustainability values into future classroom instruction. Consequently, learning activities that combine knowledge with hands-on experiences are considered more effective than conventional classroom instruction alone in developing lasting environmental awareness.

One practical strategy for promoting environmental sustainability is the implementation of ecobrick projects. An ecobrick is a reusable plastic bottle densely packed with clean and dry plastic waste, transforming non-biodegradable materials into durable construction blocks or functional products. Besides reducing plastic waste, ecobrick activities encourage people to practice waste segregation, recycling, creativity, teamwork, and problem-solving (Edike et al., 2022). Because the process is simple, affordable, and applicable in various educational settings, Ecobrick projects have increasingly been adopted in schools and universities as an environmental education initiative. Through project-based activities, participants experience sustainability directly rather than merely learning about it theoretically, making environmental concepts more meaningful. To maximize the educational impact of such activities, this community service program employed the Community-Based Research (CBR) approach. CBR is a collaborative approach that integrates research, community engagement, and problem-solving to address issues that are relevant to a particular community (Halseth et al., 2016). Unlike conventional research, CBR actively involves participants throughout the program, allowing them to identify problems, participate in planning, implement solutions, and reflect on the outcomes together with researchers (Johnson, 2016). In higher education, CBR is widely recognized as an effective approach because it connects academic knowledge with real community needs while encouraging active learning, collaboration, and social responsibility. For pre-service education teachers, this approach provides opportunities to develop professional competencies alongside environmental awareness through direct participation in meaningful community-based activities.

Previous studies such as Suhendri (2022); Susanti et al., (2025); and Lestari & Mufidah (2025) have reported positive outcomes of ecobrick implementation in improving environmental awareness, waste management behavior, and recycling skills among school students and community members. Another study from Bramwell-Lalor et al., (2020) has demonstrated that project-based environmental education can enhance students' environmental knowledge and foster collaborative learning. Meanwhile, research on Community-Based Research has emphasized its effectiveness in strengthening community participation, empowering learners, and generating sustainable local solutions. Despite these encouraging findings, this study focused either on ecobrick training as a waste management program or on CBR as a community empowerment approach. Limited attention has been given to integrating ecobrick project assistance with the CBR framework specifically for pre-service elementary education teachers in higher education. Furthermore, relatively few studies have examined how such an integrated approach contributes to the development of environmental literacy among future teachers.

The integration of ecobrick and CBR in this program provides a complementary approach in which environmental action and community participation are developed simultaneously. Ecobrick provides a concrete, practice-oriented learning experience through which participants identify plastic waste problems, apply waste management

and recycling practices, and transform plastic waste into a usable product. Meanwhile, CBR positions participants not merely as recipients of training but as active contributors who participate in identifying problems, planning activities, implementing the project, reflecting on the outcomes, and developing locally relevant solutions. Thus, the integration moves beyond conventional ecobrick training by connecting practical environmental action with participatory learning and collective problem-solving. For pre-service elementary education teachers, this integration is particularly significant because it not only develops knowledge and practical skills related to environmental issues but also provides experience in collaborative and reflective practices that can potentially be transferred to future classroom and community contexts. In this sense, the contribution of the program lies in demonstrating how ecobrick function as a participatory learning vehicle within CBR, while CBR provides the collaborative framework that strengthens the educational and community dimensions of the ecobrick project.

Based on these considerations, this community service program was designed to address the identified gap by integrating ecobrick project assistance with a Community-Based Research approach for pre-service elementary education teachers at IAIN Langsa. Accordingly, this article aims to describe the implementation of the program and examine its contribution to fostering environmental literacy. The integration is expected to provide a practical model for connecting hands-on waste management activities with participatory community engagement in teacher preparation programs. The findings may also serve as a reference for future sustainability education and community engagement initiatives in higher education, particularly those seeking to position pre-service teachers as active participants and future agents of environmental learning.

Method

This community service program employed a Community-Based Research (CBR) approach, which emphasizes collaboration between researchers and participants in identifying problems, designing solutions, implementing actions, and evaluating outcomes. The approach was selected to ensure that participants were actively involved throughout the entire process rather than serving merely as recipients of the training. Through CBR, the participants became collaborators who contributed ideas, reflected on their experiences, and developed practical solutions to environmental problems within their academic community (Beckman & Long, 2023).

The program was conducted at the Elementary Teacher Education (PGMI) Department, IAIN Langsa, Indonesia, and involved 60 pre-service elementary school teachers as participants. The primary focus of the program was the progress of ecobrick products made from collected plastic waste. The activity was implemented over four weeks, from planning to the presentation of the final products. Data were collected using

a 10-item environmental literacy questionnaire developed by the research team based on the environmental literacy dimensions discussed in previous studies, particularly environmental understanding, environmental attitudes, environmental responsibility, and pro-environmental behavior. The items were contextualized to the ecobrick project and the characteristics of pre-service elementary education teachers. Before administration, the questionnaire was reviewed by experts in environmental education to assess the relevance, clarity, and appropriateness of the items to the objectives of the program. The experts' feedback was used to revise the wording and ensure that each item appropriately represented the intended dimensions of environmental literacy. Thus, the questionnaire was used as a descriptive instrument to capture participants' self-reported environmental literacy following their participation in the program. Each item was measured using a five-point Likert scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree.

Data were analysed using descriptive statistics, including frequencies, percentages, and mean scores. The mean scores were categorized into five levels: 1.00–1.80 = very low, 1.81–2.60 = low, 2.61–3.40 = moderate, 3.41–4.20 = high, and 4.21–5.00 = very high. These categories were used to facilitate the interpretation of the participants' responses rather than to establish a diagnostic or standardized level of environmental literacy. In addition, product assessment is used to measure the process and production of ecobrick. The collected data were analysed descriptively to describe participants' engagement, learning experiences, and the outcomes of the program.

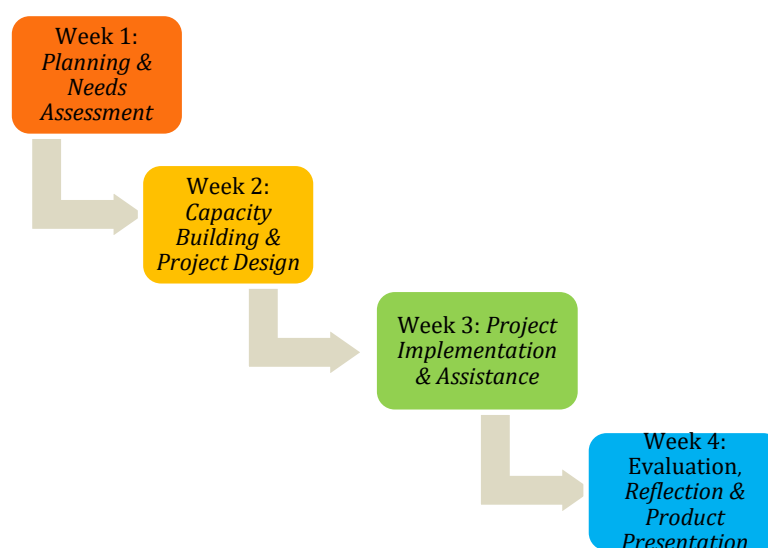


Figure 1. Framework of the Ecobrick Assistance Program

Result and Discussion

The ecobrick assistance program was implemented for four weeks using the Community-Based Research (CBR) approach involving 60 pre-service elementary education teachers from the PGMI Department of IAIN Langsa. Throughout the program,

participants were not only introduced to concepts of environmental sustainability but were also actively involved in identifying environmental problems, designing solutions, implementing activities, and reflecting on the outcomes.

1. Planning and Needs Assessment: Building Environmental Awareness

The first stage focused on identifying environmental issues related to plastic waste within the campus environment. Through group discussions, participants found that single-use plastic waste, such as snack packaging, plastic bags, and drinking bottles, constituted a significant environmental problem. Many participants initially perceived plastic waste as ordinary household waste with limited reuse value. However, after discussions on environmental sustainability and the ecobrick concept, students began to recognize plastic waste as a resource that could be transformed into useful products. This finding indicates that the planning stage contributed to improving participants' environmental knowledge, which is one of the key dimensions of environmental literacy. The CBR approach supported this process because participants actively identified problems and proposed solutions based on their own experiences. As a result, learning became more contextual and meaningful.

Capacity Building and Project Design: Developing Knowledge and Collaboration

During the second week, participants attended workshop on waste management, sustainability concepts, and ecobrick production techniques. Students learned how to select, clean, dry, and compact plastic waste into bottles to create high-quality ecobricks. They also worked collaboratively in groups to design products that could be produced from ecobricks.



Figure 2. Developing Knowledge about Ecobrick

The project design process encouraged participants to develop not only environmental knowledge but also collaboration and problem-solving skills. Each group discussed product ideas, divided responsibilities, and planned production activities. Some groups designed chairs, flower pots, small tables, decorative items, and educational media from ecobricks. These activities reflect the principles of active learning, where students construct knowledge through interaction and experience. From a CBR perspective, this stage demonstrated that participants were not passive recipients of

information. Instead, they became active contributors in planning and decision-making. Such participation is important because environmental literacy is not merely about understanding environmental issues but also about developing the capacity to take collective action for environmental improvement.

2. Project Implementation and Assistance: Transforming Waste into Valuable Products

The third week focused on the implementation of the ecobrick projects. Participants collected plastic waste from their homes, campus areas, and nearby communities. The collected waste was cleaned, sorted, and processed into ecobricks with continuous assistance from facilitators. All participant groups successfully produced ecobricks that met basic quality standards in terms of cleanliness, density, and functionality. Then they combined ecobricks into practical products such as stools, decorative furniture, and learning media for elementary school students. The production process also encouraged participants to practice creativity and teamwork while reinforcing sustainable waste management behaviors.

One important thing during this stage was the change in participants' attitudes toward plastic waste. Students who initially considered plastic waste as useless began to perceive it as a material with economic and educational value. This finding aligns with the concept of experiential learning, which suggests that direct experiences can significantly influence attitudes and behaviors. The CBR approach strengthened this process by enabling participants to engage in real environmental actions and reflect on their experiences collectively.



Figure 3. Project Implementation and Assistance

3. Evaluation and Reflection: Strengthening Environmental Literacy

In the final week, participants presented their ecobrick products and reflected on the learning experiences gained during the program. Product evaluation showed that all groups were able to produce functional and creative outputs, while reflective discussions indicated improvements in environmental awareness, responsible waste management

behavior, and collaborative skills.



Figure 4. Some of the Ecobrick Products

Meanwhile, the environmental literacy questionnaire was completed by 60 pre-service elementary education teachers after participating in the ecobrick project. Responses were analyzed using descriptive statistics, including frequencies, percentages, and mean scores.

Overall, the findings indicate that the participants demonstrated a high level of environmental literacy, as reflected by the predominance of Agree (A) and Strongly Agree (SA) responses across all questionnaire items. The mean scores ranged from 3.85 to 4.55 on a five-point Likert scale, suggesting positive knowledge, attitudes, responsibility, and environmentally responsible behaviors toward plastic waste management.

Table 1. Participants' Responses to the Environmental Literacy Questionnaire

No.	Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean
1	I understand the negative impacts of plastic waste on the environment.	0 (0.0%)	1 (1.7%)	4 (6.7%)	22 (36.7%)	33 (55.0%)	4.45
2	I know appropriate ways to reduce plastic waste in daily life.	0 (0.0%)	2 (3.3%)	6 (10.0%)	25 (41.7%)	27 (45.0%)	4.28
3	I separate recyclable plastic waste from other household waste whenever possible.	1 (1.7%)	5 (8.3%)	9 (15.0%)	28 (46.7%)	17 (28.3%)	3.92
4	I feel personally responsible for protecting the environment by reducing plastic waste.	0 (0.0%)	2 (3.3%)	7 (11.7%)	24 (40.0%)	27 (45.0%)	4.27
5	I am concerned about environmental problems caused by excessive plastic consumption.	0 (0.0%)	1 (1.7%)	3 (5.0%)	21 (35.0%)	35 (58.3%)	4.50
6	I encourage others to	1 (1.7%)	3	8	29	19	4.03

No.	Statement	SD (%)	D (%)	N (%)	A (%)	SA (%)	Mean
	practice proper plastic waste management.		(5.0%)	(13.3%)	(48.3%)	(31.7%)	
7	I try to minimize the use of single-use plastics in my daily activities.	2 (3.3%)	5 (8.3%)	11 (18.3%)	24 (40.0%)	18 (30.0%)	3.85
8	I believe that every individual plays an important role in protecting the environment.	0 (0.0%)	1 (1.7%)	2 (3.3%)	20 (33.3%)	37 (61.7%)	4.55
9	I intend to continue practicing environmentally friendly behaviors in the future.	0 (0.0%)	2 (3.3%)	5 (8.3%)	23 (38.3%)	30 (50.0%)	4.35
10	I am willing to participate in environmental conservation activities in my community.	0 (0.0%)	2 (3.3%)	6 (10.0%)	25 (41.7%)	27 (45.0%)	4.28

Participants through the questionnaire reported that the program increased their understanding of environmental issues and motivated them to adopt environmentally friendly habits, such as reducing plastic use, sorting waste, and reusing recyclable materials. Furthermore, as future elementary school teachers, participants expressed their intention to integrate sustainability concepts and ecobrick activities into their future teaching practices.

These findings suggest that environmental literacy develops more effectively when learning combines knowledge, attitudes, skills, and action. Henceforth, these outcomes support Bramwell-Lalor et al., (2020) who claim that environmental education implemented through project-based activities can increase students' understanding of environmental issues and support collaborative learning. The ecobrick project provided opportunities for participants to practice environmental responsibility directly, while the CBR approach encouraged participation and reflection of the program.

On the other hand, this program contributed to three important aspects. First, it strengthened the environmental literacy of pre-service elementary education teachers by improving their knowledge, attitudes, and sustainable behaviors. Second, it demonstrated that ecobrick projects can serve as practical and low-cost environmental education media in higher education settings. Third, it provided evidence that the CBR approach is effective in promoting active participation and collaborative problem-solving in community-based environmental programs. These findings support the previous findings as well and imply that integrating sustainability projects into teacher education programs can prepare future teachers to become agents of environmental change in schools and communities.

Conclusion

This community service program demonstrated that the integration of the Community-Based Research (CBR) approach with ecobrick project assistance effectively fostered the environmental literacy of pre-service elementary education teachers at IAIN Langsa. Through a four-week participatory process involving planning, capacity building, project implementation, and evaluation, participants not only acquired knowledge of sustainable waste management but also developed practical skills, environmental responsibility, collaboration, and problem-solving abilities. The successful production of functional ecobrick products further reflected the participants' ability to transform environmental knowledge into meaningful action. This program contributes to the field of community engagement and teacher education by offering a practical and replicable model for integrating sustainability education into pre-service teacher preparation through experiential and community-based learning. Nevertheless, this study has several limitations. The program was conducted within a relatively short period and involved participants from a single institution, limiting the generalizability of the findings. In addition, the evaluation primarily focused on participants' immediate learning outcomes and project achievements rather than the long-term sustainability of their environmental behaviors. Future community service programs are therefore recommended to involve more diverse educational institutions, extend the implementation period, and examine the long-term impact of ecobrick initiatives on environmental literacy and sustainable practices among future teachers.

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