

Synergy between Universities and Local Communities in Empowering Elementary School Teachers to Design Sustainable Environmental Education Projects

Nurdesri Juni Amelia, Dinda Kurnia, Zulkarnaini

Universitas Riau, Indonesia
nurdesri.juni6196@grad.unri.ac.id

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Abstract

Environmental education in elementary schools is constrained by limited contextual resources, predominantly theoretical instruction, and insufficient teacher capacity to design sustainable environmental projects. This study examines how collaboration between higher education institutions and local communities can support teachers in developing contextual and sustainable environmental education projects. A community-based empowerment approach combined with participatory action research (PAR) was employed, involving elementary school teachers in Cluster 3, Pasir Penyau District, Indragiri Hulu Regency, Riau Province. Activities comprised preparation, needs identification, pedagogical training, project design, learning media development, mentoring, and evaluation. Data from observations, interviews, documentation, and activity evaluations were analyzed descriptively. The findings highlight collaborative partnerships as a foundation for integrating local environmental resources, community knowledge, and project-based learning into environmental education. Proposed projects included waste sorting, composting, school greening, water conservation, and school garden development. A hybrid strategy combining printed materials, digital pocketbooks, and resources accessed through QR codes was identified to support learning accessibility and program continuity. The study presents a collaborative framework for strengthening teachers' capacity to design locally relevant environmental education projects and advancing sustainable development. Its effectiveness in improving teacher

competence and students' environmental awareness, however, requires further empirical evaluation.

Keywords: Environmental Education; Teacher Empowerment; University–Community Partnerships; Participatory Action Research; Sustainable Development

INTRODUCTION

The dynamics of environmental problems require the involvement of various stakeholders, including educational institutions, in fostering ecological awareness and sustainable behavior from an early age. Elementary schools play a strategic role in shaping students' knowledge, attitudes, and character so that they are able to understand and respond to environmental problems in their surroundings. Environmental education cannot be implemented solely through the delivery of theoretical material but needs to be developed through contextual, participatory, and action-oriented learning experiences. In this context, teachers play an important role in connecting learning materials with environmental conditions at home, at school, and in the community. Suyitno et al. (2016) discussed the use of environmental observation and the potential of local wisdom in elementary school learning. This highlights the importance of developing learning strategies that enable students to identify environmental problems through direct experiences and conditions closely related to their daily lives.

Improving the quality of environmental education also requires support for teachers' competencies in designing learning materials and media appropriate to students' characteristics. Teachers are not only expected to understand environmental concepts but also to develop learning activities that encourage students to observe, analyze, and seek solutions to ecological problems. Halimah et al. (2020) developed the Bumiku learning media as an effort to support environmental education in elementary schools. This study is relevant to the need to develop learning media that can help students understand environmental problems more concretely. In addition, Pratiwi et al. (2023) developed interactive multimedia based on project-based learning oriented toward environmental problems for elementary school students. These two studies illustrate that strengthening environmental education requires the support of learning media and strategies that encourage students' active engagement. Therefore, enhancing teachers' capacity to design environmental education

projects is an important step toward developing more meaningful and applicable learning experiences.

One approach that can be used to strengthen environmental education is the integration of local wisdom into the learning process. Local wisdom encompasses the knowledge, values, customs, and practices of communities that have developed in everyday life, including how communities utilize natural resources and maintain environmental balance. Utilizing local wisdom as a learning resource can help students understand that environmental conservation is not merely an academic concept but also a shared responsibility. Sudiartini et al. (2024) examined the application of Balinese local wisdom in learning about environmental problems among fifth-grade elementary school students. This study demonstrates the relevance of integrating local values into learning activities related to environmental conservation. In line with this, Ramadhani et al. (2025) discussed the integration of local wisdom into IPAS learning to foster environmental awareness among elementary school students. These two studies strengthen the argument that local environmental potential and the cultural values of communities can serve as a foundation for developing contextual, relevant, and ecologically oriented character-building learning experiences.

In addition to integrating local wisdom, environmental education can be developed through project-based learning, which provides students with opportunities to become directly involved in identifying problems, planning activities, implementing actions, and evaluating outcomes. This approach enables environmental learning to move beyond knowledge acquisition while also promoting the development of problem-solving skills, collaboration, creativity, and responsibility. Al-Bahij et al. (2024), for example, discussed eco-enzyme project-based learning to improve elementary school students' knowledge of waste management in relation to the Sustainable Development Goals (SDGs), particularly Target 12.5, which concerns reducing waste generation through prevention, reduction, recycling, and reuse. This study demonstrates the relevance of environmental projects as an alternative learning approach that connects knowledge with environmental management practices. Nevertheless, successful implementation depends largely on teachers' ability to determine themes, formulate objectives, organize activity stages, select media, involve the surrounding environment, and establish evaluation indicators appropriate to students' needs.

In practice, developing environmental education projects requires systematic planning skills to ensure that activities are implemented in a structured and sustainable manner. Teachers need to be able to identify environmental problems relevant to school conditions, determine the potential of local learning resources, organize activities appropriate to students' developmental stages, and design evaluation and follow-up mechanisms. If these competencies are not supported by adequate training and mentoring, environmental education risks being limited to the delivery of material or one-off activities without continuity. Therefore, teacher empowerment needs to be directed toward improving practical skills in preparing environmental education project plans that can be implemented according to the conditions of schools and communities. This effort also provides teachers with opportunities to develop learning innovations based on local potential, ensuring that environmental education activities are not only relevant to the curriculum but also beneficial to the surrounding environment.

These needs are particularly relevant to the elementary school teacher empowerment program in Cluster 3, Pasir Penyu District, Indragiri Hulu Regency, Riau Province. This program emphasizes the importance of strengthening teachers' capacity to design sustainable environmental education projects by utilizing local environmental potential and wisdom. The issues of concern include the need to develop learning materials and media, the ability to identify ecological problems in the surrounding environment, and the skills required to design structured and continuous project-based learning activities. To ensure that these issues accurately reflect the conditions of the target community, needs identification should be based on preliminary observations, interviews with teachers, or an examination of the learning materials used in schools. Based on the identified needs, the empowerment program can be designed to help teachers develop project plans that are appropriate to students' characteristics, local environmental conditions, and sustainable education objectives.

The implementation of an empowerment program also requires synergy between higher education institutions and communities. Higher education institutions possess academic resources, including lecturers' expertise, research findings, learning innovations, and student involvement, which can be utilized to help address educational problems in the community. Through community service activities and the Community Service Program (Kuliah Kerja Nyata, or Kukerta), higher education institutions can serve as partners in facilitating capacity building for teachers through training, workshops, mentoring, and project plan evaluation. Such collaboration is important because the development of

environmental education cannot depend entirely on schools but requires the involvement of families, communities, and various stakeholders. In this context, higher education institutions function not only as centers for knowledge development but also as community partners in translating academic knowledge into contextual and applicable solutions. This synergy is expected to establish an empowerment process that is not temporary but instead encourages the continuity of environmental education practices in schools.

Several previous studies have examined the development of environmental learning media, the integration of local wisdom, and the implementation of project-based learning at the elementary school level. Halimah et al. (2020) focused on the development of environmental learning media, whereas Pratiwi et al. (2023) developed interactive multimedia based on project-based learning oriented toward environmental issues. Sudiartini et al. (2024) and Ramadhani et al. (2025) highlighted the integration of local wisdom into learning to support students' environmental understanding and awareness. Meanwhile, Al-Bahij et al. (2024) discussed the implementation of waste-processing projects as part of learning relevant to sustainable development goals. These studies provide a foundation for developing contextual and practice-oriented environmental education. However, based on the areas addressed in these publications, there remains room to develop an empowerment program that specifically integrates the identification of local environmental potential, teacher mentoring in project design, the development of evaluation indicators, and the planning of activity sustainability within a single community service program. This gap provides an important basis for developing a program focused on strengthening teachers' capacities rather than solely on developing learning.

METHODS

This activity employed a Community-Based Empowerment approach combined with Participatory Action Research (PAR) to strengthen elementary school teachers' capacity to design and implement sustainable environmental education projects through collaboration among universities, schools, and local communities. PAR emphasizes community participation in problem identification, solution formulation, action implementation, and reflection (Rahmat & Mirnawati, 2020), while community-based empowerment highlights participation in program planning, implementation, monitoring, and evaluation (Firman, 2021). The University of Riau (UNRI) community service team acted as facilitators, mentors,

and evaluators, while teachers served as the primary actors in developing contextual environmental education projects.

The activity followed four stages: preparation, implementation, mentoring, and evaluation. Preparation involved identifying teachers' needs, mapping local environmental problems and potential, coordinating stakeholders, and preparing training materials and evaluation instruments. Implementation included socialization, pedagogical training, environmental project design, and the development of printed and digital learning media. Mentoring supported activities such as waste sorting, composting, school greening, water conservation, and school garden utilization. Evaluation addressed implementation processes, outputs, participant engagement, and sustainability. This participatory design integrated local potential and action-oriented empowerment (Rahmat & Mirnawati, 2020; Asmoro et al., 2021) while supporting contextual learning for elementary school students (Halimah et al., 2020).

The target participants were elementary school teachers in Cluster 3, Pasir Penyu District, Indragiri Hulu Regency, Riau Province, selected through purposive sampling based on their relevance to the program. UNRI lecturers and students supported training, technical mentoring, media development, and evaluation. Local communities and stakeholders could also contribute to problem identification and the use of environmental resources. Selection criteria included teachers' willingness to participate in training, project planning, and mentoring. This approach aligns with community empowerment principles emphasizing participation in decision-making and program development (Firman, 2021; Yunita, 2018). However, the actual participant number and selection criteria must be confirmed from implementation records.

Data were collected through observations, interviews, evaluation sheets, project assessment sheets, and documentation. Observations examined school environmental conditions, learning media availability, and relevant environmental problems. Interviews explored teachers' needs, experiences, and constraints, while documentation included training materials, modules, pocketbooks, worksheets, project designs, and activity photographs. These techniques support in-depth descriptive evaluation of empowerment activities (Yunita, 2018). Evaluation covered four aspects: input (facilities, school commitment, learning materials, and digital infrastructure); process (participant engagement and training implementation); output (learning media and project designs); and outcome

(indications of teacher competence, environmental understanding, and program sustainability). Instruments must reflect those actually used to ensure accountable reporting.

Data were analyzed descriptively and qualitatively through organization, categorization, presentation, and interpretation. Information was grouped into themes covering teachers' needs, participation, project development, local environmental potential, learning media, constraints, and sustainability. Findings were presented narratively and in matrices, with conclusions drawn through data reduction, presentation, and conclusion verification. Descriptive statistics could supplement the analysis if questionnaire or competency assessment data were available; however, changes in teacher competence or environmental behavior should only be reported when supported by systematically collected evidence.

The activity took place in Cluster 3, Pasir Penyu District, Indragiri Hulu Regency, Riau Province. The manuscript indicates 2026 in a table source note, but the exact implementation dates and duration remain unspecified. These details, including the training period and mentoring and evaluation schedules, should be verified against the community service team's records to ensure transparent reporting.

RESULTS

Characteristics of the Local Community of Indragiri Hulu and the Challenges of Environmental Education

Local communities have specific social and cultural contexts, as well as distinctive natural conditions. Therefore, the educational approaches implemented must be contextual. In Indragiri Hulu Regency, the richness and dynamics of the surrounding ecosystems offer considerable potential as an interactive natural laboratory.

As discussed by Alpusari et al., the main obstacles to environmental learning in Indragiri Hulu lie in the limited availability of contextual learning resources and media. When learning materials are presented abstractly without being connected to students' realities, the internalization of environmental awareness values will not be effective.

Several contextual project designs that teachers and students can develop together include school-based organic and inorganic waste management and sorting; upcycling programs or the reuse of solid waste; greening school areas and conserving water and energy;

establishing school gardens and developing educational pocketbooks; and implementing community-based digital environmental campaigns.

To support the success of the program in Indragiri Hulu, Universitas Riau (UNRI) performs five main functions:

1. Knowledge Provider: Disseminating the latest knowledge on sustainable environmental education to teachers.
2. Collaboration Facilitator: Connecting schools, local governments, university students, and communities within a unified partnership ecosystem.
3. Innovation Developer: Transforming research findings into practical and applicable learning instruments or media.
4. Sustainable Mentor: Providing ongoing support for project implementation in schools through regular follow-up activities after training.
5. Program Evaluator: Measuring the impact of activities on teachers' pedagogical effectiveness and changes in students' ecological behavior.

Digital transformation in environmental education is not intended to replace face-to-face interaction, but rather to expand reachability, increase engagement, and ensure program sustainability.

Table 1. Objectives of Digitalization

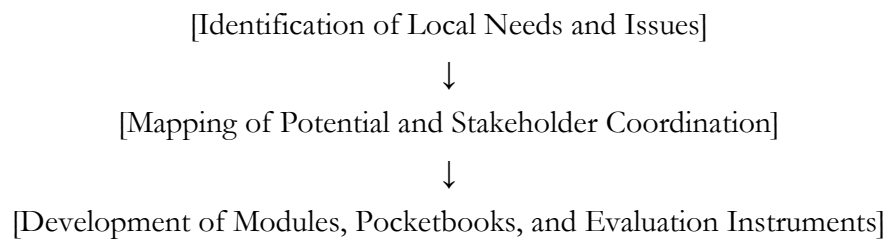
Objectives of Digitalization	Forms of Outputs and Impacts
Material Accessibility	Development of e-books, PDF modules, short videos, and infographics.
Expanded Reach	Distribution of teaching materials across schools without the limitations of physical printing.
Structured Documentation	Digital archives of photos and videos documenting activities such as tree planting, composting, and other related initiatives.
Student Creativity	Creation of digital posters, social media campaigns, and environmental journals.
Program Sustainability	Provision of a QR code-based digital pocketbook accessible via smartphones.
Inter-School Networking	Establishment of a learning community for sharing best practices.

Source: Processed by the Researchers, 2026.

Program Methodology and Implementation Stages

Preparation Stage

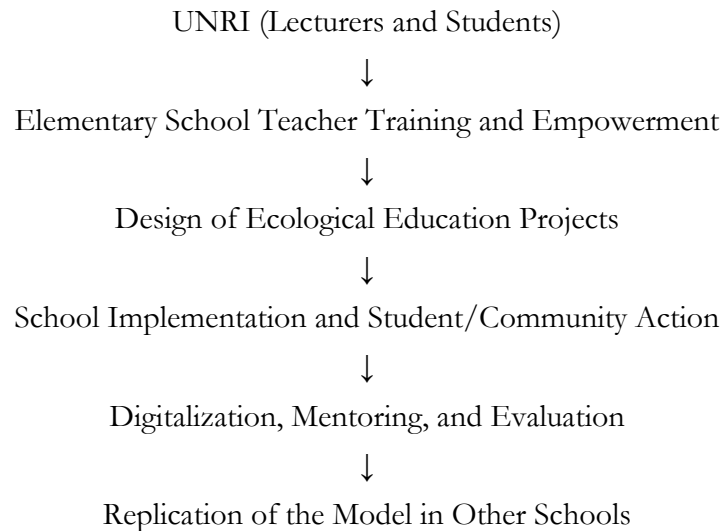
This stage is based on the principle of *Community-Based Empowerment*, in which local communities and teachers are involved from the outset in identifying problems and formulating solutions.



Field Implementation Stages

1. Socialization: Aligning perceptions regarding the urgency of sustainable development and the Sustainable Development Goals (SDGs).
2. Pedagogical Training: Enhancing teachers' capacity to design environmental projects.
3. Project Design: Developing learning scenarios, such as the "Zero-Waste School" project.
4. Media Development: Producing pocketbooks, worksheets, and digital media.
5. Learning Implementation: Carrying out projects with students in the school environment.
6. Specialized Assistance: Conducting periodic monitoring by the UNRI team to address technical challenges.
7. Impact **Evaluation**: Conducting a comprehensive assessment of the program's processes and outputs.

Partnership Program Framework



Program Evaluation and Projected Impact

Multi-Indicator Evaluation

1. Input: Availability of facilities, school commitment, quality of learning materials, and digital infrastructure.
2. Process: Participant engagement, quality of training interactions, and student participation levels.
3. Output: Number of pocketbooks and digital learning media produced, as well as the number of school project units established.
4. Outcome: Improved ecological understanding, changes in environmentally friendly behavior, and the development of school self-reliance.

Activity Impact Matrix

1. For Educators: Improved pedagogical competence, creativity in developing learning media, and digital literacy.
2. For Students: Increased environmental awareness, critical thinking skills, and action-based learning experiences.
3. For the Community: The establishment of synergistic relationships with schools as centers for community-based environmental education.

Paradigm Shift in Community Service: From a Unilateral Approach to Participatory Partnership

Historically, community service activities conducted by higher education institutions have often become trapped in top-down or one-way approaches. Under this model, universities position themselves as the sole authorities on expertise and innovation, while communities are treated merely as passive beneficiaries. In the field of ecological education at the elementary school level, this conventional model has proven less effective because it tends to produce incidental and merely formalistic programs that cease as soon as the Community Service Program (*Kuliah Kerja Nyata*, or Kukerta) or community service activities come to an end.

The collaboration between Universitas Riau (UNRI) and local communities in Indragiri Hulu Regency initiates a paradigm shift toward Participatory Partnerships Based on Community Empowerment (*Community-Based Empowerment*). Universities no longer adopt an instructive approach; instead, they assume the roles of facilitators, catalysts for innovation, and dialogic partners.

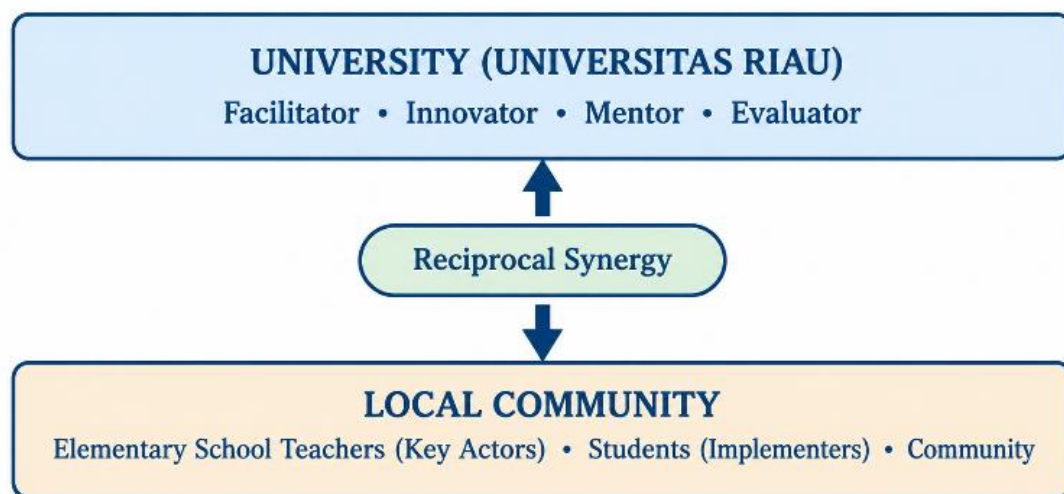


Figure 1. Collaboration Among Actors

Through this framework, circular and reciprocal interactions are established:

1. Higher Education Institutions provide theoretical frameworks, modern pedagogical methodology designs, research outputs, and access to digital technology.

2. Local Communities and Elementary School Teachers contribute contextual knowledge (*local knowledge*), in-depth mapping of empirical problems, and local wisdom (*indigenous wisdom*), which serve as the primary foundation for environmental learning.

This participatory scheme ensures that the design of ecological education projects does not appear to be externally imposed, but rather emerges from a synthesis of academic expertise and the actual needs of local residents.

Reconstructing the Role of Elementary School Teachers as Pioneers of Ecological Transformation

Elementary school teachers occupy a central position within the educational ecosystem. However, field-based problem mapping—as observed among elementary school teachers in Cluster 3, Pasir Penyu District, Indragiri Hulu—reveals several systemic barriers:

1. Limited availability of teaching materials aligned with local realities.
2. Understanding of environmental issues that remains confined to theoretical memorization from standardized texts.
3. A shortage of interactive learning facilities that utilize the potential of the surrounding ecosystem.

The empowerment initiative developed by UNRI focuses on reorienting teachers' roles, shifting them from merely being *curriculum content instructors* to becoming *designers of eco-learning projects*. Through workshops on developing pocket guidebooks and contextual learning modules, teachers are trained to identify environmental problems in their surroundings—such as domestic waste management, reforestation of school areas, and water efficiency—and subsequently transform them into interactive learning projects for students.

Table 2. Transformation of Teacher Competencies Before and After the Empowerment Initiative

Teacher Competency Domain	Condition Before Empowerment	Condition After Empowerment (Target)
Issue Understanding	Textual, general, and disconnected from local phenomena.	Contextual, based on the potential and dynamics of Indragiri Hulu.
Media Development	Passive reliance on centrally published textbooks.	Ability to independently design pocketbooks, digital media, and worksheets.
Teaching Methods	Dominance of lectures and memorization (teacher-centered).	Project-based learning (Project-Based Learning) and real-world action.

Teacher Competency Domain	Condition Before Empowerment	Condition After Empowerment (Target)
Digital Literacy	Limited to proficiency in basic applications.	Ability to use e-books, QR codes, and interactive visual media.

This capacity-building initiative provides educators with greater autonomy and confidence to design ecopedagogy that responds to the environmental conditions in which their students grow and develop.

Authentic Learning: Articulating the Ecological Potential of Indragiri Hulu as a *Living Laboratory*

Environmental education at the elementary level loses its relevance when delivered solely through abstract conceptual explanations. A fundamental principle of sustainable environmental education is the authenticity of learning materials and their close connection to students' everyday experiences.

Indragiri Hulu Regency possesses a wealth of distinctive ecosystems, encompassing river basins, plantation landscapes, and local biodiversity. Collaboration between higher education institutions and schools optimizes these natural landscapes as a *living laboratory*. Ecosystems outside the classroom no longer serve merely as a visual backdrop, but instead become the primary medium through which students observe, analyze problems, and carry out concrete actions.

Concrete projects resulting from this collaboration include:

1. "Zero-Waste School" Project: Educating students about organic and inorganic waste sorting and implementing composting practices within the school environment.
2. "School Herbal Garden and Vegetable Garden" Project: Utilizing neglected schoolyards to cultivate local vegetation in order to introduce the concepts of biodiversity and food security.
3. "Local Ecology Pocketbook" Project: Developing an illustrated guidebook discussing biodiversity and local environmental issues in Pasir Penyau District, Indragiri Hulu.

Through this scheme, students are not merely asked to memorize definitions of "pollution" or "sustainability," but are also given opportunities to experience these concepts

empirically, thereby fostering ecological empathy and the habituation of environmentally friendly behaviors from an early age.

Hybrid Approach and Program Sustainability Through Digitalization

A recurring challenge in community service activities in regional areas is ensuring sustainability after the university's mentoring period has ended. Although digitalization is often regarded as the primary solution, implementing it entirely through a *full digital* approach in Indragiri Hulu risks creating new inequalities due to internet connectivity constraints and variations in educators' digital literacy.

Based on these conditions, the most inclusive strategy agreed upon is the Hybrid Approach, which combines the strengths of physical printed media with the flexibility of digital technology.

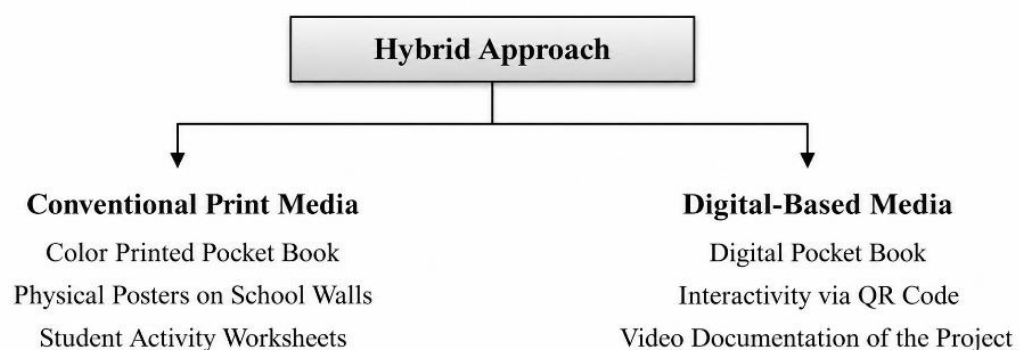


Figure 2. Hybrid Approach

The use of pocketbooks integrated with *QR codes* enables teachers and students to use the printed version during classroom activities without being constrained by internet connectivity. Meanwhile, for those with network access, the codes provide access to digital modules (*e-books*), supporting video materials, and project documentation for more exploratory learning experiences.

The sustainability of this program is maintained through systematic mentoring by UNRI lecturers and students—such as through the Sustainable Community Service Program (*Kuliah Kerja Nyata*, or Kukerta) and the Lecturer Community Service Scheme—accompanied by a comprehensive evaluation covering the *Input*, *Process*, *Output*, and *Outcome* domains.

The Strategic Contribution of University–Community Synergy to the Vision of an Advanced Indonesia

The synergy between Universitas Riau, elementary education institutions, and the community of Indragiri Hulu is not merely a means of fulfilling the administrative obligations of the Three Pillars of Higher Education (*Tri Dharma Perguruan Tinggi*), but rather a long-term investment in realizing the agenda of an Advanced Indonesia.

The achievement of the vision of an Advanced Indonesia is measured not solely by indicators of economic growth or physical development, but also by the availability of high-quality human resources who possess strong character, critical thinking skills, and an environmental mindset (*green mindset*).

1. Strengthening Social Capital (*Social Capital*): Schools develop into centers of ecological movements whose impacts extend into the domestic sphere (families) and the wider community.
2. Downstreaming Academic Expertise: The ideas and research findings of higher education institutions do not remain confined to libraries, but are transformed into applicable solutions to address challenges in local areas.
3. Accelerating SDG Targets: This initiative makes a tangible contribution to achieving the Sustainable Development Goals, particularly SDG 4 (Quality Education), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action).

This empowerment program marks a paradigm shift in community service. Higher education institutions no longer position residents as passive recipients of assistance through a *top-down* approach, but rather as collaborative subjects (*co-creators*).

Through this scheme, the relationship established is circular and reciprocal: higher education institutions transfer academic expertise, while communities contribute insights derived from local wisdom that enrich the body of research conducted by universities.

DISCUSSION

The findings indicate that synergy between higher education institutions and local communities represents an important approach to strengthening sustainable environmental education in elementary schools. The collaboration between Universitas Riau (UNRI), elementary school teachers, students, and local communities in Indragiri Hulu Regency

emphasizes that environmental education requires more than the delivery of theoretical knowledge. It also requires the development of contextual learning experiences that enable students to recognize, understand, and respond to environmental problems in their immediate surroundings. This approach positions environmental education as a learning process that connects knowledge, attitudes, and practical actions in everyday life (Suyitno et al., 2016; Alpusari et al., 2025).

One of the main findings concerns the importance of strengthening teachers' competencies in designing environmental education projects. The research identifies several challenges, including limited contextual teaching materials, the predominance of theoretical learning approaches, and insufficient utilization of the surrounding environment as a learning resource. These conditions indicate that teachers need practical support to transform environmental topics into structured learning activities. Teacher empowerment through training, workshops, the development of educational pocketbooks, and the preparation of project-based learning scenarios can provide opportunities for teachers to develop learning activities that correspond to students' needs and local environmental conditions. This finding is consistent with Alpusari et al. (2025), who examined elementary school teachers' motivation in training activities for developing educational pocketbooks on sustainable environmental education. It is also consistent with Alpusari et al. (2025), who emphasized teacher empowerment in designing sustainable environmental education projects as a practical contribution to the Sustainable Development Goals (SDGs).

Another important finding is the integration of local environmental potential and community knowledge into the learning process. The environmental characteristics of Indragiri Hulu, including river ecosystems, plantation landscapes, and local biodiversity, provide opportunities to develop authentic learning activities. The utilization of these resources enables students to examine environmental problems through direct observation and practical activities rather than relying exclusively on abstract explanations. Examples include waste sorting, composting, school greening, water conservation, and the development of school gardens. These activities can connect environmental knowledge with students' everyday experiences and encourage the development of environmental responsibility from an early age (Suyitno et al., 2016; Sudiartini et al., 2024; Ramadhani et al., 2025).

The findings also emphasize the importance of participatory partnerships between universities and local communities. In this framework, universities contribute academic expertise, research findings, pedagogical approaches, and technological resources, while teachers and communities contribute contextual knowledge, local experience, and an understanding of environmental conditions. This reciprocal relationship positions teachers and communities not merely as recipients of assistance but as active participants in identifying problems, designing solutions, and implementing environmental education projects. Such collaboration provides a basis for developing programs that are more responsive to local needs and potentially more sustainable than activities that depend entirely on external facilitators.

Furthermore, the proposed combination of printed and digital learning media represents an effort to address differences in technological access and digital literacy. Printed educational pocketbooks can support classroom learning without requiring continuous internet access, while QR codes can connect users to supplementary materials, electronic books, videos, and digital documentation. This hybrid approach is relevant to the research findings because it recognizes that technological innovation must be adapted to the conditions of the participating schools. Nevertheless, the effectiveness of this approach needs to be assessed through its actual implementation, accessibility, and use by teachers and students.

Overall, the findings suggest that sustainable environmental education depends on the integration of teacher capacity building, contextual learning resources, participatory collaboration, and appropriate educational technology. The contribution of the university–community partnership lies in connecting these elements within a program framework that encompasses preparation, training, project development, implementation, mentoring, and evaluation. However, the extent to which this framework improves teachers’ competencies and students’ environmental behavior requires further empirical assessment.

The findings are consistent with previous research on the development of environmental learning media in elementary schools. Halimah et al. (2020) developed Bumiku as an environmental learning medium, demonstrating the relevance of educational media in supporting students’ understanding of environmental issues. Similarly, Pratiwi et al. (2023) developed interactive multimedia based on project-based learning and oriented toward environmental problems for fifth-grade elementary school students. Both studies

provide a basis for understanding the importance of instructional resources that facilitate students' engagement with environmental content. The present research extends this discussion by emphasizing not only the availability of learning media but also teachers' capacity to design and integrate these resources into contextual environmental education projects.

The findings also correspond with studies examining the integration of local wisdom into environmental education. Sudiartini et al. (2024) examined the implementation of Balinese local wisdom in learning about environmental problems in elementary schools, while Ramadhani et al. (2025) discussed the integration of local wisdom into IPAS learning to foster environmental awareness among elementary school students. These studies support the relevance of connecting environmental education with local knowledge and cultural contexts. In comparison, the present research places particular emphasis on the partnership process through which teachers and communities identify local environmental potential and transform it into practical learning projects. Thus, local wisdom is positioned not only as instructional content but also as a resource for designing activities that respond to the actual conditions of the surrounding environment.

The findings are further supported by Al-Bahij et al. (2024), who examined eco-enzyme project-based learning to improve elementary school students' knowledge of waste management in relation to SDG Target 12.5. Their research illustrates the relevance of project-based activities in connecting environmental knowledge with waste management practices. The present study shares this action-oriented perspective but places greater emphasis on the preparatory and collaborative processes required to develop environmental projects, including teacher training, the preparation of learning materials, stakeholder coordination, mentoring, and program evaluation. This distinction highlights the importance of considering teachers' capacity to organize and sustain environmental learning activities rather than focusing exclusively on the learning activities themselves.

The two studies by Alpusari et al. (2025) are particularly relevant to the present research. Alpusari et al. (2025) focused on elementary school teachers' motivation in training to develop educational pocketbooks on sustainable environmental education in Indragiri Hulu. Meanwhile, Alpusari et al. (2025) addressed the empowerment of elementary school teachers to design sustainable environmental education projects in the same regency. Together, these publications provide a direct contextual basis for discussing teacher

empowerment, the development of educational resources, and the preparation of environmental projects. The present manuscript brings these concerns together within a broader framework of university–community synergy that includes participatory project design, local environmental resources, digital and printed media, ongoing mentoring, and multidimensional evaluation.

The institutional context is also relevant. Universitas Riau (2022) documented the importance of student participation through the Kukerta program, while Universitas Riau (2023) discussed the contribution of quality higher education to knowledge development and society. These institutional publications provide contextual support for understanding how university resources and student involvement can be connected with community needs. However, they should be treated as supporting institutional context rather than direct empirical evidence that the environmental education program examined in the present manuscript has achieved measurable outcomes.

Compared with the literature reviewed, the principal contribution of the present research is its emphasis on integrating several elements of environmental education into a collaborative program framework. These elements include contextual problem identification, teacher capacity building, the use of local knowledge, project development, hybrid learning media, mentoring, and evaluation. Nevertheless, because the manuscript does not report a systematic comparative evaluation of the program against alternative approaches, its contribution should be understood as a proposed integrative framework rather than demonstrated evidence of superior effectiveness.

The findings highlight the importance of strengthening teachers' competencies in designing contextual environmental education projects through training, appropriate learning materials, and practical activities. Higher education institutions can support sustainable partnerships through mentoring, resource development, and evaluation, while local communities contribute environmental knowledge and local wisdom. A hybrid approach combining printed and digital media can improve learning accessibility. These initiatives are relevant to SDGs 4, 12, and 13, although their actual impacts require systematic evaluation.

This study is limited by the lack of empirical evidence demonstrating the actual implementation and effectiveness of the proposed program. Detailed information regarding participants, data collection, and analysis is also insufficient, while the methods section remains inconsistent with the environmental education topic. Furthermore, the absence of

baseline and follow-up measurements limits the assessment of changes in teacher competence and students' environmental awareness. Differences in digital access and the study's specific geographical context may also affect program implementation and generalizability. Future research should employ systematic evaluation and involve schools across different settings to assess the program's effectiveness and sustainability.

CONCLUSION

The strategic partnership between Universitas Riau and the community of Indragiri Hulu Regency demonstrates that community service based on the Three Pillars of Higher Education (*Tri Dharma Perguruan Tinggi*) can address environmental education challenges at the elementary school level. Through teacher capacity building, the utilization of local wisdom, and support for digital transformation through a hybrid approach, this program not only creates interactive and contextual learning experiences but also fosters social capital for national development oriented toward environmental sustainability.

This study contributes to the development of environmental education by highlighting the synergy between universities, local communities, and elementary school teachers in designing contextual and sustainable environmental education projects. It emphasizes the integration of local knowledge, teacher capacity building, and project-based learning to support environmental awareness and sustainable development goals.

Future research should empirically evaluate the implementation and effectiveness of environmental education projects by measuring changes in teachers' competencies and students' environmental awareness. Studies involving diverse schools and geographical settings are also recommended to assess the program's sustainability and broader applicability.

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