



Coastal Innovative Learning for Teacher Capacity Building through Local Potential and Environmental Problems on Salemo Island

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ABSTRAK

Sekolah pesisir memiliki sumber daya ekologis, sosial, budaya, dan ekonomi yang dapat menjadi konteks pembelajaran otentik, namun praktik kelas dapat tetap berpusat pada buku teks dan terpisah dari masalah lingkungan lokal. Program layanan masyarakat ini bertujuan merancang dan menerapkan *Coastal Innovative Learning* (CIL) untuk pengembangan kapasitas guru di Pulau Salemo. CIL mengintegrasikan konteks berbasis tempat pesisir, masalah lingkungan nyata, proyek kolaboratif, dan sumber pembelajaran digital ke dalam satu kerangka pengembangan guru. Program partisipatif diorganisir melalui penilaian kebutuhan, pelatihan konseptual, lokakarya alat pelajaran, implementasi kelas, evaluasi, dan penyebaran di SMPS PGRI Pulau Salemo. Kerangka ini menetapkan empat konteks pembelajaran pesisir, sintaks CIL enam tahap, dan spesifikasi CIL Kit yang terdiri dari modul, panduan guru, lembar kerja berbasis masalah, media digital, bank proyek, instrumen penilaian, dokumentasi video, dan panduan refleksi. CIL menawarkan struktur yang dapat dipindahkan untuk pendidikan pesisir kontekstual dan pembelajaran profesional guru. Data hasil tingkat peserta yang terverifikasi dan tindak lanjut yang lebih lama masih diperlukan sebelum klaim efektivitas diajukan.

Kata Kunci: Inovatif; Kolaboratif; Lingkungan; Implementasi; Efektivitas.

ABSTRACT

Coastal schools possess ecological, social, cultural, and economic resources that can become authentic learning contexts, yet classroom practice may remain textbook-centered and detached from local environmental problems. This community service program aimed to design and implement Coastal Innovative Learning (CIL) for teacher capacity building on Salemo Island. CIL integrates coastal place-based contexts, real environmental problems, collaborative projects, and digital learning resources into a single teacher-development framework. A participatory program was organized through needs assessment, conceptual training, lesson-tool workshops, classroom implementation, evaluation, and dissemination at SMPS PGRI Pulau Salemo. The framework established four coastal learning contexts, a six-stage CIL syntax, and a CIL Kit specification comprising a module, teacher guide, problem-based worksheets, digital media, project bank, assessment instruments, video documentation, and reflection guidance. CIL offers a transferable structure for contextual coastal education and teacher professional learning. Verified participant-level outcome data and longer follow-up are still required before claims of effectiveness are made.

Keywords: Innovative; Collaborative; Environment; Implementation; Effectiveness.

INTRODUCTION

Coastal schools are situated in environments where ecological processes, livelihoods, local culture, and everyday environmental risks are visible and accessible.



Such settings can function as living laboratories when teachers connect curriculum concepts to the places where students live. Place-based education has been associated with stronger environmental literacy and stewardship because learning becomes anchored in locally meaningful phenomena and community issues (Hamilton & Marckini-Polk, 2023). In secondary science, place-based approaches have also been used to situate energy and climate topics in students' communities, demonstrating the value of context for relevance and participation (Hernandez et al., 2022). In Indonesia, environmental education that incorporates local values has been recommended so that ecological concepts are not detached from learners' lived experience (Sarbaini et al., 2022). Teachers at Salemo Island schools, where abundant coastal resources combine with environmental issues, were the target partners. Teachers were aware of their local context, but instruction was still mostly textbook-based, with little use of digital media, group projects, and coastal issues. Consequently, contextual learning innovation required more robust pedagogical and technological support.

A recent review of ethnoscience research similarly shows that local wisdom can strengthen environmental education by connecting scientific ideas with culturally embedded practices of sustainability and conservation (Sihombing et al., 2025). The pedagogical challenge is not only to expose students to environmental content, but to engage them in investigating and acting on authentic problems. Research on environmental literacy increasingly supports active models such as Project-Based Learning (PjBL) and Problem-Based Learning (PBL). STEM-PjBL has improved students' environmental literacy in biology learning (Pertiwi et al., 2024) while environment-oriented electronic PjBL supported environmental literacy and data-interpretation competence (Anwar et al., 2024). Project-based learning focused on environmental pollution has also produced meaningful gains in environmental literacy (Wicaksono et al., 2024). PBL has been reported to support creative thinking, collaboration, and environmental literacy simultaneously (Nurwidodo et al., 2024), while a humanistic PBL approach within the Merdeka Belajar context strengthened learning ownership and environmental literacy (Rahmawati et al., 2026). Mangrove-based project edu-tourism provides a particularly relevant example for coastal contexts because ecological observation, restoration, and community engagement can be combined in authentic projects (Faisal, Abd Rahman, et al., 2025). Ethno-education for sustainable development can likewise link engineering design, local knowledge, and sustainable environmental literacy (Ariyatun et al., 2025), and project-based carbon-neutral education has been shown to support environmental literacy and ecological sensitivity (Usman et al., 2025). For teachers, however, contextual and project-based learning requires more than knowledge of a pedagogical model. Teachers must be able to select digital resources, design activities, connect content to local contexts, assess complex learning, and revise instruction through reflection.

Reviews of teacher professional digital competence emphasize the importance of understanding digital resources as part of professional practice rather than as isolated technical tools (Heine et al., 2023), while systematic evidence shows that

teacher digital competence includes knowledge, skills, attitudes, and pedagogical decision making (Smestad et al., 2023). The TPACK literature also describes technology integration as complex, situated, and dynamic (Schmid et al., 2024). Teacher educators' professional agency affects whether digital competence is facilitated in transformative ways (Nagel et al., 2023). Effective PjBL training for teachers benefits from phased learning, practice, coaching, feedback, and support for transfer into classrooms (Clark & Shin, 2024). TPACK-oriented professional development similarly requires sustained integration of content, pedagogy, and technology (Ginting & Linarsih, 2022). More recent reviews emphasize contextual knowledge as a key dimension of expertise for technology-supported teaching (Brianza et al., 2024) and show that TPACK interventions need stronger alignment with participants' instructional contexts (Fabian et al. 2024; Faisal, Usman, et al. 2025).

The primary aim of this community service program is to strengthen teachers' capacity to design and implement contextual, innovative, and environmentally responsive learning by integrating Salemo Island's local potential and real environmental issues into classroom instruction. Specifically, the program aims to enhance teachers' ability to identify coastal resources and environmental problems as learning contexts, integrate them into lesson plans and project-based activities, develop appropriate digital learning media, and facilitate student-centered projects that promote environmental literacy, creativity, critical thinking, and collaborative problem-solving. Experiential learning is a form of active learning that enables students to use, reflect on, and learn from their experiences. (Syatriana et al., 2023) To support these aims, the program introduces the Coastal Innovative Learning (CIL) framework, which includes a six-stage instructional syntax and a structured CIL Kit, as a practical guide for teachers to transform coastal exploration into meaningful learning, reflection, and local environmental action.

The initial analysis for the Salemo Island program identified four interconnected needs: learning was still dominated by textbooks; coastal environmental issues such as marine waste, abrasion, mangroves, and conservation were not yet systematically embedded in lesson tools; teachers needed stronger support for digital media and project design; and students' contextualization, environmental literacy, creativity, and critical thinking required further development. The state of the art above shows strong evidence for place-based environmental learning, PBL/PjBL, and teacher digital competence, but these strands are often treated separately. The gap addressed in this community service program is the need for an integrated teacher-development model specifically organized around coastal local potential, real environmental problems, collaborative projects, and digital tools. The contribution of this program is the Coastal Innovative Learning (CIL) framework, including a six-stage instructional syntax and a structured CIL Kit that can guide teachers from coastal exploration to reflection and local action.

METHOD

Program Setting and Participations

In order to improve teachers' ability to apply Coastal Innovative Learning (CIL) on Salemo Island, this community service program coupled science and technology (S&T) dissemination with a participatory training strategy. Teachers were positioned as active participants in the program rather than just information consumers thanks to the participatory training approach. Identifying teaching challenges and local coastal potentials, talking about actual environmental problems on the island, evaluating current classroom practices, creating contextual learning activities, creating project-based learning plans, creating digital learning materials, and considering the viability of implementing the developed materials in their individual classrooms were all part of their involvement.

The community service program was conducted on 10 September 2026 at SMPS PGRI Pulau Salemo, Pulau Salemo, Mattiro Bombang Village, Liukang Tupabbiring Utara District, Pangkajene and Kepulauan Regency, South Sulawesi, Indonesia. The primary target group was coastal-school teachers, with students and the school expected to receive continuing benefits. The activity involved, 20 number of participating teachers, and was facilitated by lecturers from Universitas Muhammadiyah Makassar in collaboration with the partner school. The program used a participatory community-service approach so that local potential, teacher needs, and school conditions informed the intervention design. The flow chart of community service activities is shown in Figure 1.

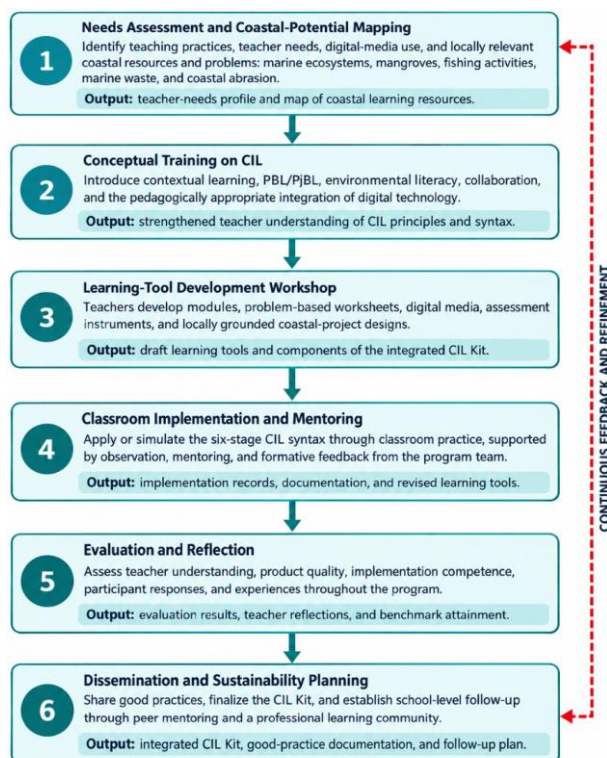


Figure 1. Proposed of the flow chart of community service activities

Needs Assessment and Coastal Learning Resources

The needs assessment focused on existing teaching practices, available lesson tools, digital-media use, and the degree to which the coastal environment had been incorporated as a learning resource. The intervention mapped four locally relevant contexts: marine ecosystems as sources for observation and concept development; mangroves as sites for local conservation learning; fishing activities as entry points for local wisdom and coastal economics; and marine waste and abrasion as authentic problems for inquiry and student projects. These contexts were then linked to lesson planning, student worksheets, digital media, assessment, and project design.

Table 1. Coastal contexts and their instructional roles in Coastal Innovative Learning

Coastal context	Instructional role	Illustrative learning focus
Marine ecosystems	Local environment as a learning resource	Biodiversity, food webs, water quality, ecological interactions
Mangroves	Observation and local conservation	Adaptation, coastal protection, habitat restoration, stewardship
Fishing activities	Local wisdom and coastal economy	Livelihoods, sustainable resource use, community knowledge
Marine waste and abrasion	Authentic problem for student projects	Waste reduction, shoreline change, problem solving, public action

Coastal Innovative Learning syntax

CIL was designed as an instructional sequence that moves students from direct engagement with the coastal context toward investigation, product development, reflection, and action. The model combines contextual learning, problem-based inquiry, project-based learning, collaboration, and digital resources. Its six stages are presented in Table 2.

Table 2. Six stages of the Coastal Innovative Learning syntax

Stage	CIL phase	Core activity
1	Coastal Exploration	Students observe local coastal phenomena, resources, livelihoods, and environmental conditions.
2	Contextual Connection	Teachers connect field observations to curriculum concepts and students' prior knowledge.
3	Problem Identification	Students formulate meaningful questions or problems related to local coastal issues.
4	Collaborative Investigation	Groups collect information, analyze evidence, discuss alternatives, and use relevant digital resources.
5	Innovative Project	Students design or produce a solution, media product, learning artifact, or environmental action project.
6	Reflection and Coastal Action	Students evaluate learning, communicate results, and plan or conduct locally relevant follow-up action.

Implementation Procedure and Evaluation Plan

The program was organized in six phases: (1) assessment of teacher needs and coastal potential; (2) training on CIL concepts and contextual strategies; (3) workshops to develop modules, student worksheets, digital media, assessments, and project designs; (4) implementation through classroom practice and mentoring; (5) evaluation through observation, reflection, and outcome measurement; and (6) dissemination of good practices and sustainability planning. This sequence was intended to move professional learning from conceptual understanding to teacher-produced learning tools and classroom enactment. The evaluation framework uses four program benchmarks: at least 80% of participating teachers demonstrate improved understanding of innovative learning; at least 80% are able to develop CIL learning tools; at least 75% can implement the model in class; and the program produces one integrated CIL Kit. Evidence should be drawn from needs-assessment records, workshop products, lesson-tool rubrics, classroom observation, teacher reflection, response questionnaires, and program documentation. Descriptive statistics (frequencies and percentages) are appropriate for benchmark attainment, while observation and reflection notes can be summarized thematically. Any pre-post inferential analysis should only be added after the underlying participant-level data are verified.

RESULTS AND DISCUSSIONS

Transforming The Coast into A Learning Laboratory

The first program output was a contextual map that reframed the coastal environment from background scenery into a structured learning resource. Marine ecosystems, mangroves, fishing activities, marine waste, and abrasion were positioned as curricular entry points rather than as extracurricular topics. This design responds directly to the initial problem of textbook-dominated instruction. It is consistent with place-based education, where the local environment becomes the organizing context for academic concepts and environmental stewardship (Hamilton & Marckini-Polk, 2023). The approach is also aligned with Indonesian evidence that environmental education becomes more meaningful when local values and local content are explicitly incorporated (Sarbaini et al., 2022).

For a small-island school, such contextualization is pedagogically important because students can observe many target phenomena directly. Instead of teaching environmental problems only as abstract cases, teachers can guide students to document shoreline change, compare waste accumulation at different points, observe mangrove structures, interview community members about resource use, or map ecological and economic relationships. These activities create a bridge between curriculum knowledge and the local social-ecological system. The design therefore gives teachers a practical route for developing literacy, critical thinking, creativity, and environmental responsibility within ordinary subject learning.

Integrating inquiry, projects, and coastal action

The six-stage CIL syntax adds an explicit progression from exploration to action. Coastal Exploration and Contextual Connection establish relevance; Problem Identification and Collaborative Investigation develop inquiry and evidence use; Innovative Project converts understanding into a tangible product or solution; and Reflection and Coastal Action reconnect learning to the community. This sequence combines strengths commonly associated with PBL and PjBL. Previous studies show that project-based and problem-based approaches can improve environmental literacy, collaboration, creative thinking, and engagement (Poulose et al., 2026). CIL extends this logic by making the coastal place itself the starting point and by requiring a final reflective or action-oriented phase. The model also reduces the risk that technology becomes an isolated add-on. Digital tools can be selected in response to each stage: mobile photography or mapping for exploration, online or offline multimedia for contextual connection, collaborative documents for investigation, design applications for project production, and digital portfolios or videos for reflection and dissemination. This situated use of technology is consistent with recent TPACK scholarship emphasizing that teacher knowledge must fit the instructional context (Brianza et al., 2024).

Teacher Capacity Building and The Coastal Innovative Learning Kit

A second major output of the program design is the shift from one-off training toward a train-design-implement-reflect cycle. Teachers first receive conceptual input, then develop concrete learning tools, test or prepare them for classroom use, and refine them through mentoring and reflection. Such sequencing is consistent with professional-development literature that emphasizes active learning, practice, feedback, coaching, and transfer to the work environment (Ginting & Linarsih, 2022). It also addresses teacher digital competence as a professional design capability rather than simply the ability to operate software (Heine et al., 2023). Program phases and expected evidence are shown in Table 1 and Figure 2.

Table 3. Program phases and expected evidence/products

Phase	Main activity	Expected evidence or product
1	Needs assessment	Teacher-needs profile and map of coastal learning potential
2	Conceptual training	Shared understanding of CIL, contextual learning, PBL/PjBL, environmental literacy, and digital learning
3	Workshop	Draft modules, worksheets, digital media, assessment tools, and student-project designs
4	Implementation and mentoring	Classroom enactment records, observation notes, revisions to learning tools
5	Evaluation and reflection	Benchmark data, teacher reflections, product-quality evidence, student participation evidence
6	Dissemination and sustainability	Good-practice sharing, documentation, and school follow-up plan



Figure 2. Syntax of Coastal Innovative Learning

The proposed CIL Kit consolidates the professional-learning products into an implementation package: a CIL module, a teacher guide for coastal learning, environmental problem-based worksheets, digital learning media, a bank of coastal projects, assessment instruments for literacy and critical thinking, video documentation of good practice, and reflection and evaluation guidance. Packaging these components is important for sustainability because it gives teachers reusable artifacts rather than leaving the program at the level of seminar knowledge. It also creates a basis for internal school mentoring and future adaptation to other coastal themes.

Evaluation benchmarks and sustainability

The program sets explicit benchmarks for teacher understanding, learning-tool development, classroom application, and production of an integrated kit. This is a strength because community-service activities are often reported only through attendance and participant satisfaction. In CIL, the more meaningful indicators concern what teachers can design and enact. A sustainability pathway is also built into the method through dissemination of good practice and school-level continuation. The intended longer-term pathway is teacher capability → improved contextual learning tools → more active student observation, discussion, projects, and problem solving → stronger environmental literacy and coastal responsibility. For future cycles, the school can strengthen this pathway by maintaining a repository of locally developed modules and project examples, scheduling peer review of learning tools, documenting student projects, and repeating environmental observations across semesters. A small school-based professional learning community would allow teachers to refine CIL across subjects rather than treating it as a single-event innovation. This recommendation is consistent with evidence that teacher digital and pedagogical competence develops through sustained, contextualized professional learning rather

than through isolated technology workshops (Schmid et al., 2024). The team of Community Service of the Coastal Innovative Learning are show in Figure 3.



Figure 3. The team of Community Service of the Coastal Innovative Learning

To evaluate the effectiveness of the training, teachers' understanding was assessed before and after the implementation of the CIL program. The pretest and posttest results demonstrated a substantial improvement in teachers' understanding after participating in the Coastal Innovative Learning (CIL) training. The average pretest score was 53.8, while the average posttest score increased to 76.6, representing an improvement of 22.8 points or approximately 42.4%. Improvements were observed across all assessed indicators, particularly in teachers' understanding of the CIL framework, its six-stage instructional syntax, and the integration of coastal environmental issues into contextual learning activities. Innovative learning is an approach or learning method that uses new, creative ways, prioritizing skills visible in student learning outcomes (Syatriana et al., 2025). The evaluation result are presented in Figure 4.

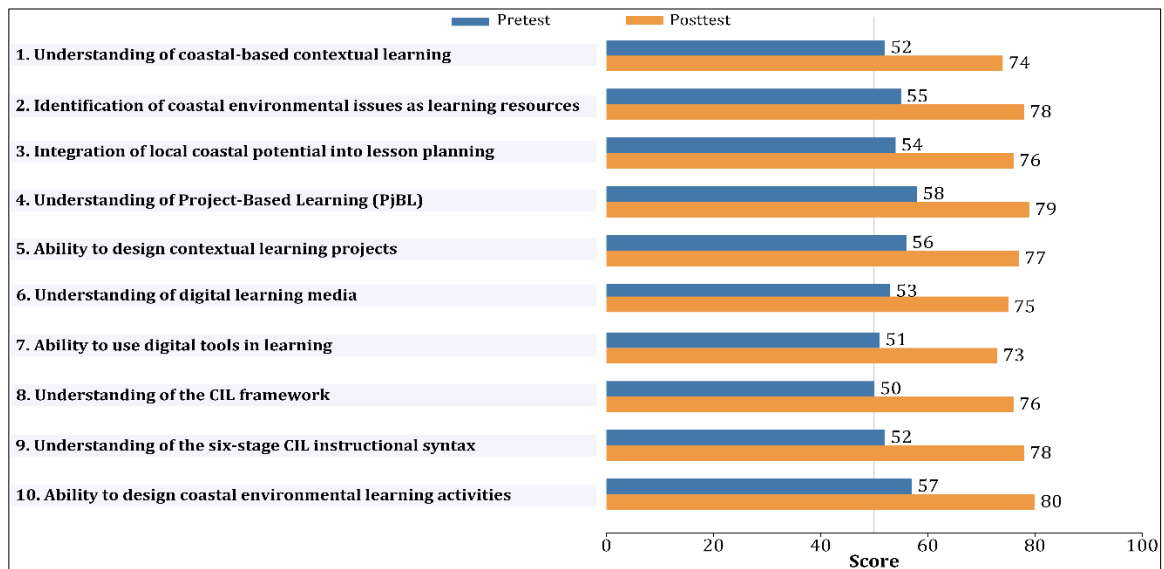


Figure 4. The Results of the Pre-test and Post-test

The supplied program documentation provides the intervention rationale, model, procedure, success benchmarks, and planned outputs, but it does not contain a verified participant count, pre-post scores, rubric results, observation frequencies, or participant-response statistics. Therefore, this manuscript intentionally does not claim statistically significant improvement or benchmark attainment. Before submission, the authors should insert the verified number of participants and actual evaluation results in Sections 2.1 and 3.4 and then revise the abstract and conclusion if the evidence supports stronger effectiveness claims. The study highlights the importance of integrating collaborative learning and problem-solving into literacy instruction and suggests that the model has broad potential for improving educational outcomes across diverse contexts (Syatriana et al., 2026). This approach avoids converting planned indicators into reported outcomes.

CONCLUSION

Coastal Innovative Learning provides an integrated framework for teacher capacity building in a coastal-school context. The model connects local coastal potential and environmental problems with contextual learning, collaborative investigation, project production, digital resources, reflection, and community-oriented action. Its six-stage syntax offers teachers a practical route from Coastal Exploration to Reflection and Coastal Action, while the CIL Kit organizes the lesson tools, media, project bank, assessment instruments, and reflection resources needed for repeated use. The framework is theoretically consistent with recent evidence on place-based environmental education, PBL/PjBL, environmental literacy, teacher professional development, and contextualized technology integration. Verified post-program data are still required to determine the degree to which the stated success benchmarks were achieved and to assess the longer-term effects on teacher practice and student learning.

RECOMMENDATION

Verified post-program assessment data should be used in future implementation to assess the degree to which the defined success indicators are met. It is also advised to do additional evaluations to look at the sustainability of CIL implementation, modifications to instructors' teaching methods, and its long-term impacts on students' involvement, critical thinking, creativity, and environmental literacy. To improve the CIL framework's applicability and sustainability, it is also advised to expand its use in additional coastal schools, conduct ongoing mentorship, and conduct regular evaluations.

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