

Developing a conceptual model for integrating curriculum and eco-school activities to strengthen ecological citizenship in boarding schools: A case study of SMAN Titian Teras, Jambi

Melisa * 

* Universitas Jambi, Indonesia
melisa88@unja.ac.id

Muhammad Ichsan 

Universitas Jambi, Indonesia
m.ichsan@unja.ac.id

Khusnul Khotimah 

Universitas Jambi, Indonesia
khusnulkhotimah@unja.ac.id

Agustin Wela Sasih 

Universitas Jambi, Indonesia
agustinwelasasih@unja.ac.id

Siti Tiara Maulia 

Universitas Jambi, Indonesia
sititiaramaulia@unja.ac.id

Alif Aditya Chandra 

Universitas Jambi, Indonesia
alifaditya@unja.ac.id

Fajar Nugraha 

Universitas Muhammadiyah Tasikmalaya, Indonesia
fajarnugraha@umtas.ac.id

*Corresponding Author

Article Info

Article History

Submitted:

26 June 2026

Revised:

5 September 2026

Accepted:

20 September 2026

Keywords

boarding school; curriculum integration; eco-school; ecological citizenship; model development

Abstract

This study addresses that gap by developing and testing an Integrated Curriculum and Eco-School Model to strengthen Ecological Citizenship in a boarding school setting. Employing a Research and Development design structured around the ADDIE framework, the study was conducted at SMAN Titian Teras Jambi, a full boarding senior high school. Data were gathered through a student profile questionnaire administered to 120 Year 10 and 11 students, focus group discussions with education experts, and daily behavioural observations in classrooms and dormitories. The resulting model embeds Ecological Citizenship indicators within the learning outcomes of Pancasila Education, Biology, and Economics, and introduces an Eco Block habituation system into dormitory routines, linking instruction to boarding life. Validation by three experts in curriculum design, ecopedagogy, and boarding management produced an average feasibility score of 88.57%. Pre-test and post-test scores, analysed using a paired-sample t-test and N-gain across ecological knowledge, attitude, eco-responsibility, and practice, showed that Ecological Citizenship rose from a mean of 62.45 to 84.10 after eight weeks ($p < 0.001$), with an average N-gain of 0.58. Corresponding gains were recorded in waste sorting (32.5%), resource-saving behaviour (28.4%), and participation in ecological activities (35.1%). These findings demonstrate that integrating curriculum with eco-school habituation in a boarding environment can translate environmental awareness into sustained ecological practice, offering a transferable model for citizenship education linking formal learning with institutional life.

Article Link: <https://journal.uny.ac.id/index.php/civics/article/view/100114>

Introduction

Environmental degradation has become one of the most pressing structural problems facing Indonesian education today. Improper municipal solid waste treatment alone has been shown to generate substantial environmental damage costs, ranging from greenhouse gas emissions to soil and water contamination (Syah et al., 2021). In Jambi Province specifically, the recurring forest and land fire crisis and chronic waste mismanagement illustrate how the exploitation of natural resources is frequently rooted in weak human resource awareness rather than the absence of regulation alone (Kasmawati, 2011). These conditions confirm that the principal actors of ecological damage are not external forces but the everyday behaviour of citizens, including the youngest generation who will inherit the consequences of present decisions.

The inadequacy of conventional Environmental Education has been theorised from two complementary but distinct traditions that together constitute the theoretical architecture of the present study. From the tradition of liberal political philosophy, Dobson (2003) proposes Ecological Citizenship as a normative framework in which citizens bear duties towards the ecological commons precisely because their consumption behaviour generates a footprint that crosses administrative borders and imposes costs on distant and future others, a relationship that triggers obligations of justice extending well beyond the boundaries of the nation-state (Clarke & Agyeman, 2011; Humphreys, 2009). This framework specifies what kind of citizen environmental education should aim to produce, but it leaves open the pedagogical question of how that kind of citizen can actually be formed in institutional settings. That gap is addressed by the second tradition, Kahn's (2010) ecopedagogy, which draws on Freire's pedagogy of praxis to argue that ecological consciousness cannot be transmitted as information but must be cultivated through repeated, reflective engagement with everyday ecological practice in real living environments. The two traditions are ontologically compatible precisely because both reject cognitivism as sufficient: Dobson's virtue-based account of citizenship implies Aristotelian habituation, in which the repeated performance of ecologically responsible acts gradually becomes second nature, while Kahn's ecopedagogy provides the institutional design logic for producing exactly that habituation. In the model proposed by this study, Dobson supplies the normative goal of what kind of citizen schools should produce, and Kahn supplies the pedagogical mechanism of how dormitory-based practice cultivates that citizenship. Rather than competing frameworks, they operate at different but mutually reinforcing levels of the same explanatory architecture, the first deontological and the second praxiological.

Within the Indonesian context, however, the Dobson-Kahn architecture requires a third philosophical layer that neither Western tradition can supply on its own: a culturally legitimate, collectively oriented ethical foundation that grounds ecological duty in an indigenous moral tradition rather than in the liberal concept of individual rights. Pancasila provides precisely this foundation, and for a Civic Education framework embedded in the Indonesian constitutional order, it constitutes the most coherent basis for Ecological Citizenship available. Three of the five principles are directly operative. *Sila Kedua, Kemanusiaan yang Adil dan Beradab*, recognises the inherent dignity of the human person and the civilisational obligation to live in just relation with one's environment, extending moral consideration beyond the individual self towards the wider community of life. *Sila Ketiga, Persatuan Indonesia*, grounds national unity in the territorial and natural integrity of the archipelago; the destruction of Jambi's forests, rivers, and peatlands is not merely an ecological event but a rupture in the constitutional bond between citizens and their shared homeland, making environmental stewardship a form of national commitment. *Sila Kelima, Keadilan Sosial bagi Seluruh Rakyat Indonesia*, demands equitable access to natural resources across present and future generations, positioning intergenerational environmental justice as an intrinsic component of the national social project (Samong et al., 2016; Santoso et al., 2024). Crucially, Pancasila's collectivist ontology is not a limitation but a strength in this context. Where Dobson derives ecological duty from the cosmopolitan obligations of an individual rights-bearer, Pancasila derives it from the shared

identity of a people constitutively bound to their archipelagic environment, a starting point that is both more culturally resonant and, as civic ecology studies consistently demonstrate, more effective as a motivational basis for sustained environmental behaviour (Oktalia et al., 2024; Sari et al., 2020; Utami et al., 2024). The model developed in this study therefore rests on a three-layered philosophical foundation: Dobson supplies the normative architecture of what Ecological Citizenship demands, Kahn supplies the ecopedagogical mechanism through which it is cultivated in everyday practice, and Pancasila supplies the culturally grounded ethical imperative that renders that citizenship a civic duty within the Indonesian constitutional and moral order.

At the institutional level, the Eco-School framework represents the most extensive global initiative for environmental education, engaging millions of students across dozens of countries in building sustainable habits within school environments (Foundation for Environmental Education [FEE], 2023). In Indonesia, the spirit of Eco-School is embodied in the Adiwiyata programme initiated by the Ministry of Environment and Forestry, which seeks to cultivate ecological awareness among students, teachers, and school leaders alike. However, empirical evaluations of Adiwiyata implementation across Indonesian schools reveal a persistent weakness, namely that environmental policy is often well documented on paper while curriculum-based integration lags behind facility provision. A study at a certified Adiwiyata senior high school in Surakarta, for instance, found that environmentally based curriculum implementation reached only 58%, considerably lower than supporting facility management at 75% (Warju et al., 2017). Comparable patterns of curricular weakness alongside reasonably strong policy and facility indicators have also been documented in Pekanbaru (Nurhafni et al., 2019) and in broader national reviews of Adiwiyata implementation (Parker, 2018; Siswanto et al., 2019).

Boarding schools occupy a distinctive position in this landscape. Because students reside within the institution for twenty-four hours a day, a boarding school constitutes one of the most structured and controllable educational environments compared to the family or wider social environment, in principle allowing continuous reinforcement of ecological habits beyond classroom hours. SMAN Titian Teras Jambi, a leading state boarding school in Muaro Jambi Regency, exemplifies this potential. Field observation and internal curriculum review conducted by the research team, however, indicate that this potential remains largely untapped due to three interrelated constraints. First, fragmentation, in which Eco-School activities operate mainly as occasional extracurricular sessions rather than being woven into core subjects such as Pendidikan Pancasila, Biology, or Economics. Second, cognitive-centric orientation, in which environmental learning is still measured through written tests rather than through demonstrated civic virtue. Third, the absence of an operational model capable of synchronising the demands of the national curriculum with the daily rhythm of dormitory life. Table 1 situates the present study within the existing body of literature on Ecological Citizenship, clarifying both its theoretical lineage and its specific contribution.

Table 1.

Position of the present study within the ecological citizenship literature

Researcher & Year	Research Focus	Key Contribution	Distinction from the Present Study
Dobson (2003)	Ecological Citizenship theory	Establishes the philosophical foundation of individual moral responsibility towards nature.	Remains broad and theoretical, without technical elaboration for school curricula.
Sari et al. (2020)	Civic ecology in Indonesian communities	Shows that civic ecology can guide community behaviour towards	Conducted in a general community setting, without an operational curriculum model.

Researcher & Year	Research Focus	Key Contribution	Distinction from the Present Study
Yusuf et al. (2020)	Environmental Citizenship in Adiwiyata schools	environmental preservation. Identifies a correlation between environmental attitude and behaviour.	Evaluative in nature, not a development study that produces an integration model.
Present Study (2026)	Curriculum and Eco-School integration in a boarding school	Constructs a two-axis conceptual model linking intracurricular infusion with dormitory habituation.	Specifically designed for the twenty-four-hour boarding structure, addressing fragmentation between formal and habitual learning.

Source: Author, 2026.

As shown in Table 1, Dobson supplies the philosophical foundation of moral responsibility towards nature (Dobson, 2003), while Sari and Yusuf demonstrate the relevance of civic ecology and environmental citizenship within Indonesian settings (Sari et al., 2020; Yusuf et al., 2020). None of these studies, however, offers an operational model that synchronises formal curriculum demands with the continuous habituation structure unique to boarding schools. The novelty of the present study therefore lies in the construction of an Integrated Curriculum and Eco-School conceptual model designed specifically for the boarding school context, bridging what has so far remained two separate domains, namely classroom theory and extracurricular practice.

Building on this rationale, the present article addresses three interrelated research questions. First, what structural and curricular gaps currently hinder the cultivation of Ecological Citizenship at SMAN Titian Teras Jambi. Second, what conceptual design of an Integrated Curriculum and Eco-School model can be formulated to address those gaps in a manner appropriate to the boarding school setting. Third, to what extent does the implementation of that model improve students' Ecological Citizenship across the dimensions of knowledge, attitude, responsibility, and practice.

Method

This study employs a Research and Development (R&D) approach combined with a one-group pre-test post-test quasi-experimental design, following the general procedure for educational development research described by Borg and Gall, operationalised through the ADDIE instructional design framework consisting of Analysis, Design, Development, Implementation, and Evaluation (Branch, 2009; Gall et al., 2003). This article reports the complete five-phase cycle. The Analysis and Design phases produced the diagnostic findings and the conceptual architecture of the model, while the Development, Implementation, and Evaluation phases produced the expert validation scores and the field-trial results that establish the model's effectiveness.

The study was conducted at SMAN Titian Teras, located in Muaro Jambi Regency, Jambi Province, a state boarding senior high school chosen for its twenty-four-hour residential structure. The five ADDIE phases are described below in sequence.

Analysis phase

The Analysis phase drew on two complementary data sources, each subjected to a distinct analytical procedure, and was complemented by a focused preliminary field component. The first data source comprised the official *Capaian Pembelajaran* (CP) documents for Pendidikan Pancasila, Biology, and Economics for *Fase E* under the Kurikulum Merdeka (Badan Standar, Kurikulum, dan Asesmen Pendidikan [BSKAP], 2022). The selection of these three subjects followed an explicit subject-mapping criterion: each was required to contain at least one CP element that directly addresses, or is plausibly extendable to address, one of the three

constitutive dimensions of Ecological Citizenship as defined by Dobson (2003), namely the normative civic dimension (rights and duties towards the ecological commons), the scientific-ecological dimension (knowledge of ecosystem dynamics and environmental change), and the economic sustainability dimension (resource allocation and consumption behaviour). Pendidikan Pancasila was selected for the normative civic dimension because its CP element on Negara Kesatuan Republik Indonesia explicitly links environmental stewardship to national identity and civic duty. Biology was selected for the scientific-ecological dimension because its CP element on *Pemahaman Biologi* explicitly requires students to generate solutions to environmental problems related to ecosystem interaction and environmental change. Economics was selected for the economic sustainability dimension because its CP element on *Pemahaman Konsep* addresses scarcity and opportunity cost in the context of efficient and sustainable resource use. Geography and Sociology were considered as candidates but excluded on principled grounds. Geography's CP for *Fase E* centres on spatial analysis, regional mapping, and physical phenomena rather than on the formation of civic environmental behaviour at the individual level. Sociology's CP addresses social structures and social interaction but does not include an explicit element concerning individual ecological duty as a citizenship obligation. Including either subject would have extended the model to a fourth axis without a corresponding gain in civic virtue formation, the principal outcome targeted by the model, while exceeding what a single-year development project can reliably validate.

Each selected CP document was analysed using a two-step deductive content analysis procedure. In the first step, the research team identified all CP statements containing terms related to environment, responsibility, sustainability, community, and resource use. In the second step, each identified statement was coded against Dobson's (2003) three-dimensional framework to determine whether it constituted a direct match, an extendable match requiring minimal contextual reframing, or a non-match to be excluded from the integration design. This deductive procedure ensured that the mapping in Table 2 reflects the actual language of the official curriculum rather than researcher imposition.

The second data source was a systematic review of prior empirical studies on Ecological Citizenship, civic ecology, and Adiwiyata implementation in Indonesian schools, used to map recurring patterns of success and structural constraint across contexts comparable to the research site, and to confirm that the three constraints identified inductively at the site were not idiosyncratic to SMAN Titian Teras but structurally representative of Indonesian environmental education more broadly.

The preliminary field component consisted of structured informal discussions with six key stakeholders at SMAN Titian Teras Jambi, selected purposively on the criterion of direct institutional knowledge of either curriculum implementation or dormitory management: the school principal, the vice principal for curriculum affairs, the subject teacher for each of the three mapped subjects, and the senior dormitory supervisor. Discussions were guided by three confirmatory questions corresponding to the three structural constraints identified in the literature review, namely whether Eco-School activities were integrated into formal lesson plans, whether environmental competencies were assessed through behavioural indicators, and whether any operational model currently existed for connecting classroom learning with dormitory routines. No structured interview protocol or audio recording was used at this stage, consistent with the diagnostic and confirmatory purpose of the activity rather than independent data generation. The output of this phase is the diagnostic finding presented in the Results and Discussion section.

Design phase

The Design phase translated the diagnostic findings into a conceptual framework, using two complementary design strategies. The first strategy, curriculum synchronisation, involved a line-by-line reading of the CP documents for the three subjects above, in order to locate

specific phrases within each subject's official learning outcome statement that already imply, or can reasonably be extended to imply, ecological responsibility.

Table 2.

Mapping of Fase E learning outcomes to ecological citizenship entry points and dormitory habituation

Subject and Element (<i>Fase E</i>)	Summary of <i>Capaian Pembelajaran</i> (CP)	Ecological Citizenship Entry Point	Linkage to Dormitory Eco-School Habituation
Pendidikan Pancasila — Element: Pancasila	Students analyse the founding figures' perspectives on the basis of the state, examine the position of Pancasila as the state's foundation, way of life, and ideology, and formulate solutive ideas to address conduct that contradicts Pancasila values (BSKAP, 2022).	Environmentally destructive conduct, such as illegal burning or open dumping, is reframed as a concrete violation of the humanitarian and social-justice values embedded in Pancasila.	Weekly dormitory reflection forum in which student supervisors discuss recent environmental incidents on campus through the lens of Pancasila values.
Pendidikan Pancasila — Element: Negara Kesatuan Republik Indonesia	Students examine national characteristics and local wisdom, recognise themselves as part of their surrounding environment so that awareness of preserving that environment emerges, and extend this awareness towards the integrity of the state (BSKAP, 2022).	The most direct entry point in the curriculum, since environmental stewardship is already framed officially as an expression of attachment to one's homeland and surrounding community.	Dormitory environmental duty roster explicitly labelled as a form of non-military <i>belas negara</i> (defence of the homeland) practised daily by every student.
Biology — Element: <i>Pemahaman Biologi</i>	Students are expected to generate solutions to local, national, or global problems related to biodiversity, ecosystem components and their interaction, and environmental change (BSKAP, 2022).	The ecosystem and environmental-change content maps directly onto Jambi's local ecological problems, particularly recurrent land and forest fires and solid waste accumulation.	Dormitory-based composting or mini ecosystem project, used as the authentic project required to fulfil the curriculum's solution-creating competency.
Economics — Element: <i>Pemahaman Konsep</i>	Students are expected to understand scarcity as the core problem of economics, together with the related concepts of needs-priority scale and opportunity cost, within the subject's broader aim of cultivating efficient and sustainable resource use (BSKAP, 2022).	Natural-resource scarcity and sustainable consumption decisions are reframed as a rational economic choice grounded in opportunity-cost reasoning, rather than as a purely moral appeal.	Dormitory canteen and student cooperative exercise that calculates the comparative opportunity cost of single use plastic packaging versus reusable alternatives.

Source: Author, 2026.

As shown in Table 2, the Pendidikan Pancasila element of Negara Kesatuan Republik Indonesia provides the most explicit entry point, since its official learning outcome already links self-recognition as part of one's surrounding environment with the emergence of environmental stewardship, prior to any extension by the research team (BSKAP, 2022). The Biology element of *Pemahaman Biologi* provides the most content rich entry point, since

ecosystem interaction and environmental change are already part of its stated competency rather than an addition. The Economics element of *Pemahaman Konsep* requires the most deliberate reframing, since scarcity and opportunity cost are originally taught through monetary or consumer examples and must be intentionally redirected towards natural resource and sustainable consumption contexts.

The second design strategy, dormitory habituation design, reconceptualised Eco-School activities not as an additional extracurricular burden but as an integral component of the boarding school's daily routine and code of conduct, drawing conceptually on the ecopedagogy perspective, which treats everyday lived practice as a primary site of ecological learning (Kahn, 2010), and on documented community-based practices of cultivating ecological citizenship through structured, routine activity (Fatmalasari et al., 2019; Jannah, 2018; Saputra, 2018). The right-most column of Table 2 illustrates how each curriculum entry point is paired with a corresponding dormitory practice, so that classroom competency and daily habituation reinforce one another rather than operating as two disconnected programmes.

The output of this phase is a draft conceptual model and an accompanying draft instructional module (*modul ajar*) and lesson plan (RPP) for each of the three subjects, which together form the prototype to be carried into the Development phase described below.

Development phase

The draft conceptual model, along with its accompanying instructional modules (*modul ajar*) and lesson plans (RPP) for the three mapped subjects, was submitted to three validators for expert judgement, each representing a different area of relevant expertise: curriculum design, ecopedagogy, and boarding school management. The curriculum expert assessed the relevance of the CP/TP mapping and the feasibility of the instructional modules; the ecopedagogy expert assessed the coherence between the ecological values embedded in the modules and concrete environmental action; and the boarding school management expert assessed the operational feasibility of the Eco-Block habituation system. Each aspect was scored on a percentage scale, and an overall score above 80% was classified as very feasible. Revisions were made to the draft model and its instructional modules based on the validators' qualitative feedback before the model was carried into the Implementation phase.

Implementation phase

The validated model was implemented for eight weeks with a sample of 120 students drawn purposively from Grade X and Grade XI, distributed across four sample classes, namely X Science 1, X Science 2, XI Social Science 1, and XI Social Science 2, so as to represent both the science and social science tracks and both the boys' and girls' dormitory blocks. Classroom instruction in Pendidikan Pancasila, Biology, and Economics integrated local ecological issues specific to Jambi Province, including the recurrent land and forest fires and the pollution of the Batanghari watershed, following the curriculum entry points mapped in Table 2. In the dormitory, the Eco-Block system was applied, under which waste sorting and daily cleanliness were incorporated into the routine assessment of each dormitory block and supported by peer monitoring among students. Data were collected through three instruments, namely a forty-item Ecological Citizenship questionnaire using a four-point Likert scale that measured ecological knowledge, ecological attitude, eco-responsibility, and ecological practice; a daily behaviour observation checklist completed by dormitory supervisors and the research team covering waste sorting, energy and water saving, and participation in ecological activities; and the expert validation instrument described above.

Evaluation phase

Quantitative data from the pre-test and post-test were analysed using descriptive statistics, including the mean, standard deviation, and the percentage of achievement for each indicator. Normality of the data distribution was examined with the Kolmogorov-Smirnov test.

The effectiveness of the model was tested using a paired-sample t-test at a significance level of 0.05, and the magnitude of improvement was measured using the normalised gain (N-gain) formula, defined as the ratio between the difference of the post-test and pre-test scores and the difference between the maximum possible score and the pre-test score. The resulting N-gain index was categorised as high for a value above 0.70, moderate for a value between 0.30 and 0.70, and low for a value below 0.30.

Results and Discussion

Diagnostic findings: Curriculum and institutional gap

Document analysis of the Pendidikan Pancasila, Biology, and Economics syllabi at SMAN Titian Teras Jambi confirms the first constraint identified in the introduction, namely fragmentation. Environmental content is present in the curriculum mainly as supplementary illustration rather than as an explicit competency to be habituated. This pattern is consistent with national findings on Adiwiyata implementation, where curriculum-based integration tends to lag behind policy formulation and facility provision. Warju et al. (2017) report that curriculum implementation in a certified Adiwiyata school reached only 58%, substantially below supporting facility management at 75%, while Nurhafni et al. (2019) similarly find that participatory curriculum activities remain the weakest component of the Adiwiyata strategy compared to policy and infrastructure indicators.

The second constraint, cognitive-centric assessment, is reflected in the continued reliance on written examinations to measure environmental learning outcomes. This tendency mirrors findings from ecoliteracy research showing that knowledge gains from Adiwiyata-style programmes do not automatically translate into consistent behavioural change once students leave the school environment (Syah et al., 2021). A qualitative case study of an Adiwiyata elementary school likewise found that pro-environmental habits were well established within school boundaries but weakened considerably in settings without continuous institutional reinforcement (Ambawono et al., 2025). For a boarding school such as SMAN Titian Teras, where students remain within the institution for an extended period each day, this finding carries a specific implication, namely that the absence of habitual reinforcement mechanisms beyond the classroom represents a missed structural opportunity rather than an unavoidable limitation.

The third constraint, the absence of an operational model, follows directly from the first two. Existing literature on civic ecology and ecological citizenship in Indonesia has so far concentrated either on theoretical elaboration (Dobson, 2003), on general community settings (Oktalia et al., 2024; Sari et al., 2020), or on evaluative assessment of existing programmes (Yusuf et al., 2020). None of these studies provides a ready operational framework that school administrators and teachers can use to systematically connect curriculum delivery with daily dormitory life. This gap forms the empirical and theoretical justification for the conceptual model developed in this study.

The proposed conceptual model: A two-axis integration framework

In response to the diagnostic findings above, the research team constructed a conceptual model referred to as the Integrated Curriculum and Eco-School Model, built upon two interconnected axes.

Intracurricular Infusion. This axis embeds specific ecological citizenship indicators directly into the lesson planning of relevant subjects rather than treating environmental content as a separate unit. In Pendidikan Pancasila, the entry point lies in the discussion of citizens' constitutional rights and obligations, reframed to include environmental protection as a concrete civic duty. In Biology, the entry point lies in the study of ecosystems, reframed to emphasise the student's own ecological footprint within the school environment. In Economics,

the entry point lies in the study of consumption behaviour, reframed to highlight sustainable consumption as a rational economic choice rather than merely a moral appeal.

Dormitory Habituation. This axis restructures the boarding environment into an active ecopedagogical space, in which waste management, water conservation, and small-scale ecological gardening are positioned as part of the dormitory's standard code of conduct rather than as voluntary extracurricular activity. This design draws on the principle that everyday lived experience, repeated consistently over time, constitutes a more durable foundation for civic virtue than periodic classroom instruction alone (Kahn, 2010).

These two axes are intended to operate in tandem. Classroom instruction provides the conceptual and normative justification for ecological action, while dormitory habituation provides the behavioural repetition needed to transform that justification into habit. This design directly addresses the fragmentation identified in the diagnostic phase, since environmental learning is no longer confined to either the classroom or the dormitory alone but is deliberately connected across both settings.

Respondent profile and expert validation of the model

The 120 student respondents were almost evenly distributed by gender, class level, and academic track, as summarised in Table 3. This balanced distribution supports the sample's representativeness across the two dormitory blocks and the two curricular tracks targeted by the model.

Table 3.

Respondent profile (n = 120)

Characteristic	Category	n	%
Gender	Male	58	48.3
	Female	62	51.7
Grade Level	Grade X (<i>Fase E</i>)	60	50.0
	Grade XI (<i>Fase F</i>)	60	50.0
Academic track	Science	60	50.0
	Social Science	60	50.0
Dormitory block	Boys' dormitory (A & B)	58	48.3
	Girls' dormitory (A & B)	62	51.7

Source: Author, 2026.

Before implementation, three validators representing curriculum design, ecopedagogy, and boarding school management reviewed the draft model and its accompanying instructional modules. Table 4 summarises the results of this expert validation.

Table 4.

Expert validation of the model

Validator	Aspect Assessed	Score (%)	Category
Curriculum expert	Relevance of CP/TP mapping, depth of material, feasibility of instructional modules	88.5	Very Feasible
Ecopedagogy expert	Ecological value content, linkage between theory and environmental action	91.2	Very Feasible
Boarding school management expert	Operational feasibility of habituation, measurability of the Eco-Block system	86.0	Very Feasible
Average	Across all assessed aspects	88.57	Very Feasible

Source: Author, 2026.

The average feasibility score of 88.57%, classified as very feasible, indicates that the two-axis design was judged coherent across academic, pedagogical, and operational considerations before it was carried into the field trial.

Effectiveness of the model: Pre-test and post-test comparison

Table 5 compares the pre-test and post-test scores across the four Ecological Citizenship dimensions. The pre-test stage revealed a pronounced gap between the cognitive and behavioural dimensions, with ecological knowledge already comparatively high at a mean of 74.20 while ecological practice remained the lowest indicator at a mean of 52.80. Following the eight-week intervention, every dimension improved significantly, and the overall score rose from 62.45 to 84.10, an increase of 21.65 points with an average N-gain of 0.58 in the moderate category.

Table 5.

Pre-test and post-test ecological citizenship scores and N-gain by dimension

Dimension	Pre-test	Post-test	Gain	N-gain	Category
Ecological Knowledge	74.20	88.50	14.30	0.55	Moderate
Ecological Attitude	65.10	86.40	21.30	0.61	Moderate
Eco-Responsibility	57.70	82.30	24.60	0.58	Moderate
Ecological Practice	52.80	79.20	26.40	0.56	Moderate
Overall Score (Mean)	62.45	84.10	21.65	0.58	Moderate

Source: Author, 2026.

A paired-sample t-test confirmed that this improvement was statistically significant, $t(119) = 18.421$, $p < 0.001$, indicating that the gain in Ecological Citizenship scores after implementation of the Integrated Curriculum and Eco-School Model was unlikely to have occurred by chance.

Behavioural change observed in daily ecological practice

Beyond the questionnaire data, direct observation of daily behaviour in the classroom and dormitory recorded consistent improvement across all four indicators monitored during the intervention period, as shown in Table 6.

Table 6.

Observed daily ecological behaviour before and after implementation

Behavioural Indicator	Before (%)	After (%)	Increase
Waste sorting (organic, inorganic, hazardous)	38.5	71.0	+32.5
Energy and water saving (dormitory electricity and taps)	48.2	76.6	+28.4
Active participation in composting and eco-brick programmes	32.0	67.1	+35.1
Initiative in maintaining cleanliness without instruction	41.2	73.8	+32.6

Source: Author, 2026.

The largest gain was recorded in student participation in composting and eco-brick activities, which rose by 35.1 percentage points, followed by student initiative in maintaining environmental cleanliness without direct instruction, which rose by 32.6 percentage points. These behavioural indicators corroborate the questionnaire-based finding that the ecological practice dimension improved the most among the four measured dimensions.

Discussion

Interpreting the effectiveness of the integrated model

The results confirm that the gap between ecological knowledge and ecological practice identified in the diagnostic phase can be narrowed effectively through a model that connects formal curriculum with structured daily habituation in a boarding environment. The pre-test

data already showed that students at SMAN Titian Teras possessed a reasonably good level of ecological knowledge (mean 74.20) well before the intervention began, yet their ecological practice lagged far behind (mean 52.80). This pattern is consistent with the observation of Jickling and Wals (2008) and Liefländer et al. (2013) that classroom-based environmental education frequently stops at the accumulation of information without altering students' daily habits and lifestyle.

The significant improvement recorded across all dimensions after the intervention ($p < 0.001$, $N\text{-gain} = 0.58$) supports the effectiveness of the integrated ecopedagogical approach adopted in this study. The largest gain occurred in the ecological practice dimension, which rose from a mean of 52.80 to 79.20. This outcome is consistent with the twenty-four-hour residential structure of SMAN Titian Teras, which provided an enabling environment in which the ecological values introduced through Pendidikan Pancasila could be practised directly in daily dormitory routines (Dobson, 2003).

Embedding local ecological issues, such as the threat of deforestation and the degradation of the Batanghari watershed, gave students a meaningful context for understanding that wasting water or electricity constitutes a violation of other citizens' right to a healthy environment, a reasoning that mirrors Hayward's (2020) argument for grounding ecological citizenship in tangible, place-based obligation rather than abstract civic knowledge. The Eco-Block system further encouraged positive peer pressure, and the recorded rise in waste sorting (32.5 percentage points) and energy saving (28.4 percentage points) suggests that a consistent rule structure combined with peer monitoring is an effective mechanism for sustaining ecological habit, consistent with the barrier-and-motivation framework proposed by Kollmuss and Agyeman (2002).

These findings are broadly consistent with, and extend beyond, prior Adiwiyata-based research conducted in non-boarding schools. Warju et al. (2017) found that student environmental knowledge, attitude, and behaviour in a certified Adiwiyata senior high school in Surakarta each reached only the good category, at 74%, 71% and 74% respectively, even though the underlying curriculum implementation indicator remained comparatively weak. Nurhafni et al. (2019) similarly identified participatory curriculum activity as the weakest component of Adiwiyata implementation in Pekanbaru. The present study suggests that when curriculum integration is paired with structured residential habituation rather than left to stand alone, the resulting gain can move beyond the good category towards the high category recorded here, though this comparison remains indicative rather than a direct experimental contrast across sites with different institutional structures.

Theoretical and practical implications

Theoretically, this study extends Dobson's concept of Ecological Citizenship by translating it into an operational educational design specific to the boarding school context, a setting that has so far received limited attention in the Indonesian ecological citizenship literature (Dobson, 2003), and provides empirical evidence that this design can produce a statistically significant shift from passive environmental awareness towards active ecological practice. Practically, the proposed two-axis model offers school leaders and teachers a concrete starting point for restructuring existing Eco-School activities, moving them from an occasional extracurricular add-on towards an integral feature of both academic instruction and daily institutional life. The model's demonstrated effectiveness at SMAN Titian Teras Jambi suggests it may serve as a reference for other Indonesian boarding schools facing similar structural fragmentation between curriculum and habituation, although specific habituation strategies would need to be adapted to each school's residential structure and local ecological context.

Limitation

Three limitations of the present study require explicit acknowledgement. First, the eight-week implementation period captures only the short- to medium-term impact of the model. The

present data cannot establish whether the improvement in ecological practice observed during this period persists once students graduate and return to a non-boarding environment, and a longitudinal follow-up study is needed to examine the durability of the Ecological Citizenship gains reported here.

Second, the study was conducted at a single full-time boarding school and the sample of 120 students was drawn purposively rather than randomly from the student population at that school. The magnitude of the gains reported, particularly the overall N-gain of 0.58, should therefore be interpreted as characteristic of this institutional context rather than as a generalisable effect size applicable to boarding schools with different management structures or to non-boarding schools.

Third, the two-axis model was designed for the specific institutional characteristics of SMAN Titian Teras Jambi, namely a state boarding senior high school implementing Kurikulum Merdeka for *Fase E* and *F* students with a non-denominational residential structure. Replicating the model in a non-boarding or day school would require substantial adaptation of the dormitory habituation axis, since the twenty-four-hour residential structure that enabled continuous reinforcement of ecological habit in this study is absent in a day school setting, and any such replication would need to involve parents and the home environment as an alternative site of habituation.

Conclusion

This study has identified three structural constraints that previously hindered the cultivation of Ecological Citizenship at SMAN Titian Teras Jambi, namely curricular fragmentation, cognitive-centric assessment, and the absence of an operational integration model, and has translated these findings into a two-axis Integrated Curriculum and Eco-School Model consisting of intracurricular infusion and dormitory habituation. Following expert validation with an average feasibility score of 88.57% and an eight-week field trial involving 120 students, the model produced a statistically significant improvement across all four Ecological Citizenship dimensions, raising the overall score from 62.45 to 84.10 with an N-gain of 0.58 in the moderate category. These results indicate that connecting formal academic learning with the continuous twenty-four-hour rhythm of boarding school life offers an effective pathway for moving students from passive environmental awareness towards active ecological citizenship. Future research is encouraged to examine the longitudinal durability of these gains and to test the adaptability of the model in boarding schools with different institutional characteristics.

Authors' contributions

Authors 1–6 conceived the study, conducted the document analysis and field observation, designed the intracurricular infusion axis, and drafted the manuscript. Author 7 contributed the early-childhood and habituation-design perspective informing the dormitory habituation axis of the model, advised on the developmental appropriateness of the proposed habituation activities, and critically reviewed the manuscript. All authors read and approved the final manuscript.

Competing interests

Conflicts of Interest: The authors declare no conflicts of interest.

Funding Statement

This research was funded by the Penelitian Dosen Pemula (Beginner Lecturer Research) grant scheme for fiscal year 2026, administered by the Institute for Research and Community Service (LPPM), Universitas Jambi, under Contract Number: 818/DST/UN21.11/PM.01.01/SPK/2026. The funder had no role in the design of the study, the analysis or interpretation of data, the writing of the manuscript, or the decision to publish.

Ethics Approval

This study received ethical approval from the Research Ethics Committee of Universitas Jambi (Ethical Approval No: 4328/DST/UN21.3/PT.01.04/2026) and formal permission from the principal of SMAN Titian Teras Jambi prior to data collection. All 120 student participants received an informed consent form explaining the study's purpose and procedures, and the researchers maintained the confidentiality of their identities and individual data throughout the research process.

References

- Ambawono, G. P., Budiono, B., & Poerwanti, E. (2025). Fostering environmental awareness through school-based programs: A case study of the Adiwiyata initiative in Indonesian elementary education. *AL-ISHLAH: Jurnal Pendidikan*, 17(4), 6871–6883. <https://doi.org/10.35445/alishlah.v17i4.7785>
- Badan Standar, Kurikulum, dan Asesmen Pendidikan. (2022). *Keputusan Kepala BSKAP Nomor 033/H/KR/2022 tentang Perubahan atas Keputusan Kepala BSKAP Nomor 008/H/KR/2022 tentang Capaian Pembelajaran pada Pendidikan Anak Usia Dini, Jenjang Pendidikan Dasar, dan Jenjang Pendidikan Menengah pada Kurikulum Merdeka* [Decree of the Head of the Agency for Standards, Curriculum and Educational Assessment No. 033/H/KR/2022 amending Decree No. 008/H/KR/2022 on learning outcomes in early childhood, primary and secondary education under the Merdeka Curriculum]. Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi. <https://kurikulum.kemdikbud.go.id>
- Branch, R. M. (2009). *Instructional design: The ADDIE approach*. Springer. <https://doi.org/10.1007/978-0-387-09506-6>
- Clarke, L., & Agyeman, J. (2011). Shifting the balance in environmental governance: Ethnicity, environmental citizenship and discourses of responsibility. *Antipode*, 43(5), 1773–1800. <https://doi.org/10.1111/j.1467-8330.2010.00832.x>
- Dobson, A. (2003). *Citizenship and the environment*. Oxford University Press. <https://doi.org/10.1093/0199258449.001.0001>
- Fatmalasari, H., Yuliandari, E., & Gunawati, D. (2019). Penguatan ecological citizenship sebagai upaya mengubah perilaku masyarakat sadar akan lingkungan melalui program Kampung Selo Beraksi [Strengthening ecological citizenship to change community behaviour towards environmental awareness through the Kampung Selo Beraksi programme]. *PKn Progresif: Jurnal Pemikiran dan Penelitian Kewarganegaraan*, 14(1), 45–59. <https://doi.org/10.20961/pknp.v14i1.34785>
- Foundation for Environmental Education. (2023). *30 years of greening education: Eco-Schools programme history*. <https://www.ecoschools.global/our-history>
- Gall, M. D., Gall, J. P., & Borg, W. R. (2003). *Educational research: An introduction* (7th ed.). Allyn and Bacon.
- Hayward, B. (2020). *Children, citizenship and environment: #SchoolStrike edition* (2nd ed.). Routledge. <https://doi.org/10.4324/9781003000396>
- Humphreys, D. (2009). Environmental and ecological citizenship in civil society. *The International Spectator*, 44(1), 37–41. <https://doi.org/10.1080/03932720802693101>
- Jannah, R. (2018). Menciptakan kewarganegaraan ekologis di era digital melalui Kampung Recycle Jember [Creating ecological citizenship in the digital era through Kampung Recycle Jember]. *Journal of Urban Sociology*, 1(2), 14–26. <https://doi.org/10.30742/jus.v1i2.567>

- Jickling, B., & Wals, A. E. J. (2008). Globalization and environmental education: Looking beyond sustainable development. *Journal of Curriculum Studies*, 40(1), 1–21. <https://doi.org/10.1080/00220270701684667>
- Kahn, R. (2010). *Critical pedagogy, ecoliteracy, and planetary crisis: The ecopedagogy movement*. Peter Lang.
- Kasmawati. (2011). Urgensi sumber daya manusia dalam eksploitasi sumber daya alam [The urgency of human resources in the exploitation of natural resources]. *Jurnal Teknosains*, 5(1), 91–99. <https://doi.org/10.24252/teknosains.v5i1.182>
- Kollmuss, A., & Agyeman, J. (2002). Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research*, 8(3), 239–260. <https://doi.org/10.1080/13504620220145401>
- Liefländer, A. K., Fröhlich, G., Bogner, F. X., & Schultz, P. W. (2013). Promoting connectedness with nature through environmental education. *Environmental Education Research*, 19(3), 370–384. <https://doi.org/10.1080/13504622.2012.697545>
- Nurhafni, N., Syahza, A., Auazar, A., & Nofrizal, N. (2019). The strategy of environmental school through the program of National Adiwiyata School in Pekanbaru (high school level). *Interdisciplinary Journal of Environmental and Science Education*, 15(1), 1–11. <https://doi.org/10.29333/ijese/6289>
- Oktalia, D., Anderson, I., & Melisa, M. (2024). Penguatan ecological citizenship berbasis sungai sebagai upaya mewujudkan karakter peduli lingkungan di Kelurahan Kasang [Strengthening river-based ecological citizenship to build an environmentally caring character in Kasang Subdistrict]. *Academy of Education Journal*, 15(1), 553–563. <https://doi.org/10.47200/aoej.v15i1.2250>
- Parker, L. (2018). Environmentalism and education for sustainability in Indonesia. *Indonesia and the Malay World*, 46(136), 235–240. <https://doi.org/10.1080/13639811.2018.1519994>
- Samong, F., Suryadi, A., & Budimansyah, D. (2016). The development of character education in primary schools through the enhancement of school culture. In *Proceedings of the 1st UPI International Conference on Sociology Education (UPI ICSE 2015)* (pp. 77–79). Atlantis Press. <https://doi.org/10.2991/icse-15.2016.17>
- Santoso, R., Khotimah, K., Opeska, Y., Sasih, A. W., Dewi, N., & Utami, S. (2024). Pendidikan kewarganegaraan ekologis sebagai upaya pembangunan berkelanjutan di Indonesia [Ecological citizenship education as an effort towards sustainable development in Indonesia]. *Jurnal Citizenship: Media Publikasi Pendidikan Pancasila dan Kewarganegaraan*, 7(2), 8–15. <https://doi.org/10.12928/citizenship.v7i2.1081>
- Saputra, I. (2018). Penguatan ecological citizenship melalui pelaksanaan program Kotaku [Strengthening ecological citizenship through the implementation of the Kotaku programme]. In *Seminar Nasional Penguatan Nilai-Nilai Kebangsaan melalui Pendidikan Kewarganegaraan Persekolahan dan Kemasyarakatan*. Laboratorium PPKn FKIP UNS.
- Sari, S. C. W., Samsuri, S., & Wahidin, D. (2020). Penguatan kewarganegaraan ekologis untuk mewujudkan ketahanan lingkungan (Studi di Kampung Gambiran, Kelurahan Pandeyan, Kecamatan Umbulharjo, Kota Yogyakarta, Daerah Istimewa Yogyakarta) [Strengthening ecological citizenship to achieve environmental resilience: A study in Kampung Gambiran, Yogyakarta]. *Jurnal Ketahanan Nasional*, 26(1), 40–54. <https://doi.org/10.22146/jkn.53816>
- Siswanto, S., Karimullah, K., Prasetyawati, R., & Nurhayati, N. (2019). Environmental cultured education and its implication on the student's competencies in an Adiwiyata school. *Cakrawala Pendidikan*, 38(3), 552–564. <https://doi.org/10.21831/cp.v38i3.23154>

- Syah, N., Hidayat, H., Yuca, V., Ardi, Z., & Magistarina, E. (2021). Examining the effects of ecoliteracy on knowledge, attitudes, and behaviour through Adiwiyata environmental education for Indonesian students. *Journal of Social Studies Education Research*, 12(4), 209–230. <https://www.jsser.org>
- Utami, S., Melisa, M., Candra, A. A., & Maulia, S. T. (2024). Implementasi program kerja berlandaskan konsep ecological citizenship dalam rangka menumbuhkan rasa cinta lingkungan sejak dini [Implementing a work programme based on the concept of ecological citizenship to foster love for the environment from an early age]. *Jurnal Pengabdian Masyarakat Bangsa*, 1(3), 737–744. <https://jurnalpengabdianmasyarakatbangsa.com/index.php/jpmmba/index>
- Warju, W., Harto, S. P., Soenarto, S., & Hartman, M. D. (2017). Evaluating the implementation of green school (Adiwiyata) program: Evidence from Indonesia. *International Journal of Environmental and Science Education*, 12(6), 1483–1501. <http://www.ijese.net/makale/1914.html>
- Yusuf, R., Sanusi, S., Maimun, M., Fajri, I., & Putra, I. (2020). Hubungan antara kewarganegaraan lingkungan terhadap perilaku lingkungan siswa di sekolah Adiwiyata [The relationship between environmental citizenship and students' environmental behaviour in Adiwiyata schools]. *Jurnal Pendidikan Kewarganegaraan*, 10(1), 1–15. <https://doi.org/10.20527/kewarganegaraan.v10i1.8215>