



Transformative Education for Sustainable Development: Building Resilience through Environmental Literacy among Students of Initao College

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Abstract. This study examines the influence of Transformative Education for Sustainable Development (TESD) on the environmental literacy and resilience of students enrolled in the Environmental Science course at Initao College, a rural higher education institution in Misamis Oriental, Philippines. Grounded in UNESCO's framework on Education for Sustainable Development, the research responds to the increasing demand for academic institutions to cultivate sustainability competencies that enable learners to address complex ecological issues. Using an explanatory sequential mixed-methods design, the study first collected quantitative data from Bachelor of Elementary Education students via a researcher-developed survey, followed by qualitative thematic analysis of open-ended responses to contextualize the quantitative results. Findings reveal a high level of TESD implementation across four dimensions: curriculum integration, values formation, community immersion, and student-led initiatives. Students exhibited strong environmental literacy and resilience across knowledge, practical skills, attitudes, and community involvement. Statistical analysis indicated significant positive correlations ($r_s = .785$, $p < .001$) between transformative learning experiences and environmental literacy outcomes, with student-led initiatives showing particularly strong associations. Qualitative results further highlighted enhanced environmental awareness, increased motivation to participate in sustainability projects, development of ecological values, and greater application of learning to real-life contexts. However, challenges emerged, including limited community cooperation, insufficient facilities and resources, personal motivational barriers, and cultural norms that impede sustainable practices. In response, the study proposes Project LUNTIAN, a localized and institutionalized environmental education initiative designed to embed sustainability in the curriculum, promote student leadership, strengthen community partnerships, and align with Sustainable Development Goals, particularly SDGs 4, 11, 13, and 15. Overall, the study underscores the potential of transformative sustainability education to foster environmentally responsible and resilient learners who can contribute to community-based ecological stewardship.

Keywords: *Environmental Literacy, Transformative Education, Sustainable Development, Student Engagement, Project LUNTIAN.*

INTRODUCTION

The accelerating climate crisis and environmental degradation demand a reorientation of education toward sustainability. UNESCO defines Education for Sustainable Development (ESD) as equipping learners with the knowledge, skills, values, attitudes, and behaviors needed to support environmental, economic, and social well-being (UNESCO, 2023). In the Philippines, a climate-vulnerable archipelago, schools remain highly susceptible to typhoons, floods, and coastal hazards, making sustainability education essential (Department of Education, n.d.). Although national policies such as RA 9729 mandate climate and disaster education, transformative sustainability teaching in higher education remains limited. Balanay and Halog (2016) note that progress beyond mandated courses such as NSTP has been minimal, while UNICEF Philippines (2023) observes that climate education is often fragmented and lacks contextual depth.

Globally, integrating ESD and global citizenship is widely regarded as crucial to addressing complex environmental challenges, as reflected in SDG 4.7 (UNESCO, 2023). Strengthening environmental literacy, defined as the knowledge, attitudes, and skills enabling informed decision-making (Wheaton et al., 2018), contributes to resilience and adaptive capacity (Rahman et al., 2025). This need is evident in local settings such as Initao, Misamis Oriental, where environmental vulnerability heightens the importance of sustainability education (Bañez, 2025).

Recent scholarship emphasizes the role of transformative educational approaches in cultivating ecological awareness and practical environmental stewardship (Eslit & Michael, 2023; Soriano et al., 2024; Batchar et al., 2025). However, gaps persist in evaluating how such approaches shape students' sustainable behaviors, community engagement, and resilience, especially in rural tertiary institutions. Studies highlight the potential of values-based, action-oriented strategies such as community immersion and student-led initiatives to deepen ecological literacy (Ariyatun et al., 2024; Lualhati et al., 2018).

This study addresses these gaps by examining the influence of transformative ESD on the environmental literacy and resilience of Initao College students who have completed the Environmental Science course (Park, 2024). Hence, this study aims to examine the influence of transformative education for sustainable development (TESD) on the environmental literacy and resilience of students at



Initao College who have completed the Environmental Science subject. As the global call for sustainability grows more urgent, educational institutions play a vital role in equipping students with the knowledge, values, and skills needed to address environmental challenges, especially in local communities like Initao, Misamis Oriental. Despite the inclusion of environmental topics in the curriculum, there is a need to assess the extent to which these educational experiences shape students' ecological awareness, sustainable practices, and community involvement. Moreover, the effectiveness of values-based and action-oriented strategies such as community immersion and student-led initiatives has yet to be systematically evaluated in the context of a rural tertiary institution. While many Philippine ESD initiatives focus on basic education, little is known about outcomes in higher education or rural campuses. By focusing on Initao College, this study addresses the lack of empirical research on transformative sustainability education in a Philippine LUC context.

Specifically, the study seeks to answer the following questions:

1. What is the level of implementation of transformative education for sustainable development in the Environmental Science subject in terms of:
 - a. Curriculum Integration,
 - b. Values Formation,
 - c. Community Immersion, and
 - d. Student-led Initiatives?
2. What is the level of environmental literacy and resilience among students in terms of:
 - a. Knowledge and Awareness,
 - b. Skills and Practices,
 - c. Attitudes and Values, and
 - d. Community Engagement?
3. Is there a significant relationship between students' experiences of transformative education and their level of environmental literacy and resilience?
4. What challenges and opportunities do students encounter in applying their environmental knowledge and values within their communities?
5. What environmental initiative can be developed based on the findings?

It explores not only knowledge acquisition but also the application of concepts and the development of resilient mindsets needed to navigate environmental risks

(Husamah et al., 2025; Ariyatun et al., 2024). Research underscores the value of interdisciplinary approaches and real-world learning in enhancing environmental problem-solving and proactive engagement (Santiani et al., 2024; Duran & Mariñas, 2024). Strengthening these dimensions is vital for advancing sustainability education in the Philippines and supporting global sustainability efforts. Ultimately, this study seeks to inform curriculum and pedagogical practices that integrate environmental care and disaster risk reduction to build a more environmentally literate and resilient student population (Fandi et al., 2025; Lualhati et al., 2018; Ibáñez, 2025). It evaluates the current state and perceived effectiveness of transformative ESD within the Environmental Science program at Initao College (Eslit & Michael, 2023), aligning with international calls to enhance sustainability education in support of the 2030 Sustainable Development Goals (Hnatyuk et al., 2024; Hakiki & Saputra, 2024).

Environmental literacy is widely recognized as a central outcome of environmental education, encompassing knowledge, awareness, attitudes, and the ability to engage in environmentally responsible actions (Ariyatun et al., 2024). Studies underscore that strengthening these competencies prepares learners to understand ecological concepts, develop positive environmental attitudes, and adopt sustainable behaviors (Bercasio & Remolacio, 2022; Ibrahim et al., 2025). Guevara (2015) shows that integrating sustainable development themes in ecology courses enhances science literacy and encourages sustainable lifestyles. Likewise, awareness of sustainability has been linked to improved environmental attitudes and motivations, offering insights for curriculum designers seeking to promote sustainable actions (Zakarneh et al., 2025). Environmental education also fosters landscape literacy and aesthetic appreciation, further enriching students' ecological understanding (Ikhsan et al., 2019).

Higher education institutions play a vital role in fostering environmental literacy through interdisciplinary and experiential approaches (Li et al., 2025). Effective environmental education goes beyond theoretical instruction, incorporating outdoor learning, research-based tasks, and community engagement to develop critical thinking and problem-solving skills related to complex environmental issues (Ikhsan et al., 2019; Filho et al., 2024). Harmoko et al. (2024) emphasize aligning these approaches with global mandates for quality education that strengthen environmental responsibility. Park (2024) highlights that experiential learning



fosters empathy and holistic engagement with sustainability. Transformative strategies require integrating sustainability into teaching, research, and community service to instill ecological awareness and pro-environmental behaviors (Ivanov et al., 2021; Nguyen-Dinh & Zhang, 2025). Through such integration, universities become hubs for cultivating environmentally responsible thinking and action (Fernández et al., 2023; Vladova, 2023). The adaptation of curricula to shifts in ecological and socio-economic conditions is essential for generating environmentally friendly behavior patterns in society (Nováková & Němejč, 2024).

Global education frameworks stress the need for transformative education to address social, ecological, and economic challenges (Ikhsan et al., 2019). Yet despite these international imperatives, there is limited empirical evaluation of the direct impact of transformative ESD on student outcomes. Leifler and Enberg (2020) note that substantial gaps persist in measuring resilience and environmental literacy outcomes, especially in rural higher education contexts. This challenge is particularly evident in the Philippines, where environmental issues vary by locality and require adaptive, context-specific approaches. Localized research highlights the importance of contextualizing environmental education to community realities (Bercasio & Remolacio, 2022; Corpuz et al., 2022). However, long-term impacts of environmental programs on community behavior and environmental health remain underexplored (Tanveer, 2025).

Values-driven and action-oriented approaches, such as community immersion, student-led initiatives, and practical applications, are increasingly recognized for their role in fostering ecological awareness and sustainable behaviors (Galorio & Naling, 2024; Gani et al., 2023). These strategies create meaningful learning opportunities that strengthen environmental accountability and promote active community engagement (Catuday, 2023; Duran & Mariñas, 2024). Since future educators significantly influence sustainability advocacy, integrating environmental education into teacher training programs remains essential (Corpuz et al., 2022). Grounding sustainability in local contexts is vital for ensuring relevance and fostering meaningful environmental participation (Corpuz et al., 2022).

Despite increasing research on sustainability education, systematic evaluations of transformative ESD implementation in rural Philippine tertiary institutions remain

scarce. Studies reveal limited examination of how specialized environmental curricula contribute to ecological literacy and resilience (Eslit & Michael, 2023). There is also a paucity of research establishing models for rural institutions facing distinct socio-environmental challenges (Agea et al., 2009). Understanding these gaps is crucial for strengthening the capacity of local communities to cope with environmental risks.

Given these gaps, evaluating transformative ESD within Environmental Science programs becomes essential. Studies of educational interventions demonstrate the importance of aligning pedagogical approaches with transformative learning principles and sustainability objectives (Shaherani et al., 2024; Rogayan & Nebrida, 2019). At the program level, this involves assessing the integration of sustainability content, the use of participatory and experiential methods, and the development of student competencies in environmental literacy (Corpuz et al., 2022). Pada et al. (2025) argue that such evaluations help determine whether educational strategies genuinely enhance sustainability competencies. The current study, therefore, examines the implementation of transformative ESD in the Environmental Science subject at Initao College, focusing on how these approaches shape students' knowledge, attitudes, and behaviors regarding environmental issues.

Methodology

This study employed an explanatory sequential mixed methods research design, a structured approach that begins with the collection and analysis of quantitative data, followed by qualitative inquiry to enrich and clarify the initial results. This design was selected to provide both measurable insights and deeper explanations regarding how transformative education for sustainable development influences environmental literacy and resilience among students. The quantitative phase enabled the researcher to determine the levels of implementation and environmental literacy and to examine the relationships among variables, while the qualitative phase provided valuable narratives that explained students' lived experiences, challenges, and opportunities in applying their environmental learning.

The research was conducted at Initao College, focusing on third-year Bachelor of Elementary Education (BEED) students enrolled in the Teacher Education Program who had completed the Environmental Science course. These



participants were selected because they had already been exposed to transformative education and environmental sustainability concepts, making them suitable respondents for the study. An a priori power analysis using G*Power 3.1.9.7 determined a minimum sample size of 99 participants (two-tailed, $\alpha = .05$, power = .86, expected correlation effect size = .30), confirming the adequacy of the sample for the planned correlation analysis.

Data collection used a researcher-made instrument developed to capture both quantitative and qualitative information. The research instrument consists of four parts. The first part gathers demographic information such as program, year level, and group section. The second part uses a four-point Likert scale to assess the implementation of transformative education for sustainable development, with reliability coefficients indicating strong internal consistency for curriculum integration (.887), values formation (.908), community immersion (.888), student-led initiatives (.853), and an overall reliability of .954. The third part measures students' environmental literacy and resilience through another four-point Likert scale, yielding reliability coefficients of .888 for knowledge and awareness, .849 for skills and practices, .910 for attitudes and values, .857 for community engagement, and an overall reliability of .950. The fourth part includes open-ended questions to gather qualitative insights.

The quantitative data gathered were analyzed using descriptive statistics, particularly mean and standard deviation, to identify the levels of implementation and environmental literacy. Spearman's rho correlation was used to test the relationship between transformative education and environmental literacy and resilience, aligning with the non-parametric nature of Likert-scale data. Meanwhile, qualitative responses from Part IV were examined through thematic analysis, enabling the researcher to identify recurring patterns, insights, and emerging themes that complemented the quantitative findings.

The data gathering procedure adhered to ethical research standards. Prior to data collection, approval was secured from the Initao College Office of the Vice President for Research, Development, and Extension Services (IC-OVPRDES). Participants were informed about the purpose of the study and given the option to participate voluntarily via an informed consent form embedded in the online survey. The questionnaire was administered via Google Forms, ensuring accessibility, confidentiality, and convenience for all respondents. All data were treated with

strict confidentiality, and findings were reported in aggregate form to protect participants' identities.

RESULTS

Problem 1: What is the level of implementation of transformative education for sustainable development in the Environmental Science subject in terms of Curriculum Integration, Values Formation, Community Immersion, and Student-led Initiatives?

Table 1

Level of Implementation of Transformative Education for Sustainable Development in the Environmental Science Subject in terms of Curriculum Integration

Indicators	Mean	SD	Interpretation
1. The Environmental Science subject covered relevant environmental topics.	3.43	0.50	Strongly Agree
2. I gained an understanding of key sustainability issues through the lessons.	3.35	0.50	Strongly Agree
3. Lessons included local examples, such as coastal conservation and solid waste management.	3.47	0.50	Strongly Agree
4. The subject helped me connect environmental theories with real-life situations.	3.51	0.52	Strongly Agree
5. Environmental problems discussed in class encouraged critical thinking and problem-solving.	3.47	0.50	Strongly Agree
Grand Mean	3.45	0.42	Strongly Agree

The findings in Table 1 show that the level of implementation of transformative education for sustainable development in the Environmental Science subject, in terms of curriculum integration, is high. Respondents strongly agreed that the subject covered relevant environmental topics ($M = 3.43$, $SD = 0.50$), helped them understand key sustainability issues ($M = 3.35$, $SD = 0.50$), included local examples such as coastal conservation and solid waste management ($M = 3.47$, $SD = 0.50$), connected environmental theories to real-life situations ($M = 3.51$, $SD = 0.52$), and promoted critical thinking and problem-solving regarding environmental problems ($M = 3.47$, $SD = 0.50$). The overall grand mean of 3.45 ($SD = 0.42$) indicates strong agreement among students regarding effective curriculum integration. This suggests that the Environmental Science curriculum effectively embeds sustainability concepts, linking theory and practice and fostering students' analytical and problem-solving skills to address environmental issues.



Table 2

Level of Implementation of Transformative Education for Sustainable Development in the Environmental Science Subject in terms of Values Formation

Indicators	Mean	SD	Interpretation
1. The subject instilled in me the importance of environmental responsibility.	3.45	0.50	Strongly Agree
2. I have developed a stronger commitment to environmental protection after completing the course.	3.42	0.50	Strongly Agree
3. I now view sustainability as an essential part of my personal values.	3.53	0.50	Strongly Agree
4. I became more conscious of the environmental impact of my everyday actions.	3.44	0.52	Strongly Agree
5. I now advocate for sustainable behavior within my peer groups and family.	3.41	0.50	Strongly Agree
Grand Mean	3.45	0.43	Strongly Agree

The results in Table 2 indicate that the Environmental Science subject effectively promotes values formation related to sustainability. Students strongly agreed that the course instilled a sense of environmental responsibility ($M = 3.45$, $SD = 0.50$), strengthened their commitment to environmental protection ($M = 3.42$, $SD = 0.50$), integrated sustainability into their personal values ($M = 3.53$, $SD = 0.50$), increased awareness of the environmental impact of daily actions ($M = 3.44$, $SD = 0.52$), and encouraged advocacy for sustainable behavior among peers and family ($M = 3.41$, $SD = 0.50$). With a grand mean of 3.45 ($SD = 0.43$), the course strongly fosters positive environmental values. This implies that the subject not only builds knowledge but also shapes students' attitudes and behaviors, motivating them to adopt and promote sustainable practices in their personal and social contexts.

Table 3

Level of Implementation of Transformative Education for Sustainable Development in the Environmental Science Subject in terms of Community Immersion

Indicators	Mean	SD	Interpretation
1. I participated in environmental activities outside the classroom, such as clean-ups or tree planting.	3.39	0.51	Strongly Agree
2. The subject encouraged community-based learning and involvement.	3.44	0.52	Strongly Agree
3. I became more aware of environmental issues in our locality through immersion or fieldwork.	3.41	0.52	Strongly Agree
4. I was able to apply classroom knowledge during community-based activities.	3.44	0.52	Strongly Agree
5. I saw the value of engaging with local communities to address environmental concerns.	3.46	0.54	Strongly Agree
Grand Mean	3.43	0.43	Strongly Agree

The data in Table 3 show that the Environmental Science subject strongly supports community immersion as part of transformative education for sustainable

development. Students reported active participation in environmental activities outside the classroom, such as clean-ups and tree planting ($M = 3.39$, $SD = 0.51$), and agreed that the course encouraged community-based learning and involvement ($M = 3.44$, $SD = 0.52$). They also became more aware of local environmental issues through fieldwork ($M = 3.41$, $SD = 0.52$), applied classroom knowledge in community activities ($M = 3.44$, $SD = 0.52$), and recognized the value of engaging with local communities to address environmental concerns ($M = 3.46$, $SD = 0.54$). The grand mean of 3.43 ($SD = 0.43$) indicates strong agreement, suggesting that the course effectively integrates practical community engagement, linking theoretical learning with real-world environmental action.

Table 4

Level of Implementation of Transformative Education for Sustainable Development in the Environmental Science Subject in terms of Student-led Initiatives

Indicators	Mean	SD	Interpretation
1. I took part in student-led campaigns or projects focused on environmental protection.	3.26	0.51	Strongly Agree
2. I feel confident to initiate or join environmental advocacy programs.	3.34	0.48	Strongly Agree
3. Our class encouraged collaboration on student-led environmental activities.	3.42	0.52	Strongly Agree
4. I helped plan or organize activities related to environmental education.	3.19	0.51	Agree
5. I consider myself an active participant in peer-driven sustainability efforts.	3.32	0.53	Strongly Agree
Grand Mean	3.31	0.40	Strongly Agree

The findings in Table 4 indicate that the Environmental Science subject strongly fosters student-led sustainability initiatives. Students generally agreed that they participated in campaigns or projects on environmental protection ($M = 3.26$, $SD = 0.51$), felt confident to initiate or join advocacy programs ($M = 3.34$, $SD = 0.48$), and experienced collaborative support in class for student-led activities ($M = 3.42$, $SD = 0.52$). While involvement in planning or organizing activities scored slightly lower ($M = 3.19$, $SD = 0.51$), students still considered themselves active participants in peer-driven sustainability efforts ($M = 3.32$, $SD = 0.53$). The grand mean of 3.31 ($SD = 0.40$) reflects strong agreement overall, suggesting that while students are engaged in leading initiatives, there is room to further enhance opportunities for them to take ownership and actively organize environmental programs.



Problem 2: What is the level of environmental literacy and resilience among students in terms of Knowledge and Awareness, Skills and Practices, Attitudes and Values, and Community Engagement?

Table 5

Level of Environmental Literacy and Resilience in terms of Knowledge and Awareness

Indicators	Mean	SD	Interpretation
1. I can explain environmental issues like climate change, biodiversity loss, and pollution.	3.27	0.51	Strongly Agree
2. I am knowledgeable about proper waste management practices.	3.38	0.51	Strongly Agree
3. I understand how human activities affect ecosystems, especially in coastal areas.	3.42	0.50	Strongly Agree
4. I am aware of the environmental challenges specific to our locality.	3.41	0.52	Strongly Agree
5. I can articulate the importance of environmental sustainability to others.	3.33	0.47	Strongly Agree
Grand Mean	3.37	0.42	Strongly Agree

The data in Table 5 reveal that students demonstrate a high level of environmental literacy and resilience in knowledge and awareness. They strongly agreed that they can explain environmental issues such as climate change, biodiversity loss, and pollution ($M = 3.27$, $SD = 0.51$), are knowledgeable about proper waste management practices ($M = 3.38$, $SD = 0.51$), and understand the effects of human activities on ecosystems, particularly in coastal areas ($M = 3.42$, $SD = 0.50$). Students also reported awareness of environmental challenges in their locality ($M = 3.41$, $SD = 0.52$) and felt capable of articulating the importance of sustainability to others ($M = 3.33$, $SD = 0.47$). The grand mean of 3.37 ($SD = 0.42$) indicates strong agreement, suggesting that the Environmental Science subject effectively equips students with the knowledge and awareness needed to understand and address environmental issues, fostering both literacy and resilience.

Table 6.

Level of Environmental Literacy and Resilience in terms of Skills and Practices

Indicators	Mean	SD	Interpretation
1. I apply the 3Rs (Reduce, Reuse, Recycle) in my daily routines.	3.43	0.54	Strongly Agree
2. I conserve energy and water at home or school.	3.46	0.52	Strongly Agree
3. I use my knowledge to make sustainable choices (e.g., eco-friendly products).	3.43	0.54	Strongly Agree
4. I practice waste segregation consistently.	3.42	0.52	Strongly Agree
5. I have adopted greener habits since taking the subject.	3.35	0.50	Strongly Agree

Grand Mean	3.42	0.41	Strongly Agree
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The findings in Table 6 indicate that students exhibit a high level of environmental literacy and resilience in their skills and practices. Respondents strongly agreed that they apply the 3Rs (Reduce, Reuse, Recycle) in daily routines ($M = 3.43$, $SD = 0.54$), conserve energy and water at home or school ($M = 3.46$, $SD = 0.52$), and use their knowledge to make sustainable choices, such as selecting eco-friendly products ($M = 3.43$, $SD = 0.54$). They also consistently practice waste segregation ($M = 3.42$, $SD = 0.52$) and have adopted greener habits since taking the subject ($M = 3.35$, $SD = 0.50$). The grand mean of 3.42 ($SD = 0.41$) reflects strong agreement, suggesting that the Environmental Science subject effectively translates environmental knowledge into actionable skills, fostering sustainable behaviors and practical environmental stewardship among students.

Table 7

Level of Environmental Literacy and Resilience in terms of Attitudes and Values

Indicators	Mean	SD	Interpretation
1. I believe every individual has a role in environmental protection.	3.53	0.50	Strongly Agree
2. I feel personally responsible for the condition of the environment.	3.52	0.50	Strongly Agree
3. I am willing to change my lifestyle to be more environmentally friendly.	3.48	0.50	Strongly Agree
4. I value the long-term impact of environmental actions.	3.49	0.50	Strongly Agree
5. I am proud to be part of a sustainability-focused education program.	3.49	0.50	Strongly Agree
Grand Mean	3.50	0.43	Strongly Agree

The results in Table 7 show that students strongly exhibit positive attitudes and values toward environmental literacy and resilience. They strongly agreed that every individual has a role in environmental protection ($M = 3.53$, $SD = 0.50$) and feels personally responsible for the condition of the environment ($M = 3.52$, $SD = 0.50$). Students also expressed a willingness to adopt a more environmentally friendly lifestyle ($M = 3.48$, $SD = 0.50$), to value the long-term impact of environmental actions ($M = 3.49$, $SD = 0.50$), and to take pride in being part of a sustainability-focused education program ($M = 3.49$, $SD = 0.50$). With a grand mean of 3.50 ($SD = 0.43$), the findings suggest that the Environmental Science subject effectively cultivates strong pro-environmental attitudes and values, reinforcing students' commitment to sustainability both personally and socially.

Table 8



Level of Environmental Literacy and Resilience in terms of Community Engagement

Indicators	Mean	SD	Interpretation
1. I have shared environmental knowledge with others in my community.	3.31	0.53	Strongly Agree
2. I have volunteered for environmental programs outside the college.	3.27	0.57	Strongly Agree
3. I am interested in future environmental outreach or advocacy projects.	3.42	0.50	Strongly Agree
4. I am aware of community-based environmental efforts in Initao.	3.38	0.51	Strongly Agree
5. I support the implementation of an environmental project or initiative to promote sustainability in Initao College.	3.37	0.53	Strongly Agree
Grand Mean	3.35	0.42	Strongly Agree

The findings in Table 8 indicate that students demonstrate a strong level of environmental literacy and resilience through community engagement. Respondents strongly agreed that they share environmental knowledge with others in their community ($M = 3.31$, $SD = 0.53$) and volunteer for environmental programs outside the college ($M = 3.27$, $SD = 0.57$). They also showed interest in participating in future environmental outreach or advocacy projects ($M = 3.42$, $SD = 0.50$), were aware of community-based environmental efforts in Initao ($M = 3.38$, $SD = 0.51$), and supported the implementation of sustainability initiatives at Initao College ($M = 3.37$, $SD = 0.53$). With a grand mean of 3.35 ($SD = 0.42$), these results suggest that the Environmental Science subject effectively fosters students' active engagement with their communities, promoting environmental awareness, participation, and advocacy beyond the classroom.

Table 9

Relationship between Students' Experiences of Transformative Education and their Level of Environmental Literacy and Resilience

Transformative Education for Sustainable Development		Level of Environmental Literacy and Resilience			
		r_s value	p -value	Interpretation	Decision
Curriculum Integration	Knowledge and Awareness	0.622	<.001	Significant (Moderate Correlation)	Reject H_0
	Skills and Practices	0.519	<.001	Significant (Moderate Correlation)	Reject H_0
	Attitudes and Values	0.614	<.001	Significant (Moderate Correlation)	Reject H_0
	Community Engagement	0.530	<.001	Significant (Moderate Correlation)	Reject H_0

Values Formation	Knowledge and Awareness	0.663	<.001	Significant (Moderate Correlation)	Reject H ₀
	Skills and Practices	0.564	<.001	Significant (Moderate Correlation)	Reject H ₀
	Attitudes and Values	0.612	<.001	Significant (Moderate Correlation)	Reject H ₀
	Community Engagement	0.518	<.001	Significant (Moderate Correlation)	Reject H ₀
Community Immersion	Knowledge and Awareness	0.666	<.001	Significant (Moderate Correlation)	Reject H ₀
	Skills and Practices	0.607	<.001	Significant (Moderate Correlation)	Reject H ₀
	Attitudes and Values	0.653	<.001	Significant (Moderate Correlation)	Reject H ₀
	Community Engagement	0.532	<.001	Significant (Moderate Correlation)	Reject H ₀
Student-led Initiatives	Knowledge and Awareness	0.735	<.001	Significant (High Correlation)	Reject H ₀
	Skills and Practices	0.726	<.001	Significant (High Correlation)	Reject H ₀
	Attitudes and Values	0.669	<.001	Significant (Moderate Correlation)	Reject H ₀
	Community Engagement	0.689	<.001	Significant (Moderate Correlation)	Reject H ₀
Transformative Education for Sustainable Development	Level of Environmental Literacy and Resilience	0.785	<.001	Significant (High Correlation)	Reject H₀

The results in Table 9 indicate a significant positive relationship between students' experiences of transformative education for sustainable development and their level of environmental literacy and resilience. Curriculum integration showed moderate correlations with knowledge and awareness ($r_s = 0.622$), skills and practices ($r_s = 0.519$), attitudes and values ($r_s = 0.614$), and community engagement ($r_s = 0.530$), all with p -values $< .001$, indicating statistical significance. Similarly, values formation and community immersion were moderately correlated with all aspects of environmental literacy and resilience, with r_s values ranging from 0.518 to 0.666, also significant at $p < .001$. Student-led initiatives demonstrated high correlations with knowledge and awareness ($r_s = 0.735$) and skills and practices ($r_s = 0.726$), while showing moderate correlations with attitudes and values ($r_s = 0.669$) and community engagement ($r_s = 0.689$), all statistically



significant. Overall, the aggregate relationship between transformative education and environmental literacy and resilience was high ($r_s = 0.785$, $p < .001$). These findings suggest that the more students engage in transformative education experiences, the higher their environmental knowledge, skills, attitudes, values, and community involvement, underscoring the effectiveness of the curriculum in fostering comprehensive environmental literacy and resilience.

These findings are consistent with UNESCO's Education for Sustainable Development (ESD) framework, which emphasizes that meaningful learning occurs when sustainability is embedded in curriculum, values, community engagement, and learner participation. The significant relationships observed across all dimensions suggest that transformative education extends beyond the acquisition of environmental knowledge to the development of pro-environmental values, practical competencies, and active civic participation. The particularly strong association between student-led initiatives and environmental literacy further supports transformative learning theory, which posits that learners develop lasting behavioral change when they actively engage in authentic, participatory, and reflective learning experiences. This implies that integrating experiential and student-centered approaches within Environmental Science courses can cultivate environmentally literate and resilient individuals who are better prepared to contribute to sustainable development in their local communities.

Table 10

Difficulties Encountered in Applying Environmental Knowledge in Real-Life Settings

Main Themes	Sub-themes	Significant Statements	General Description of the Theme
1. Lack of Support, Awareness, and Cooperation	1.1 Lack of cooperation from peers and community	• "Lack of support or awareness from others..." (S1, S4, S12, S37, S63) • "Many people didn't care about the environment." (S2) • "Not everyone practices eco-friendly habits..." (S61, S62, S69, S72, S73, S83, S98, S99) • "Others aren't listening." (S91) • "Some people weren't interested." (S27, S85)	This theme highlights that individual environmental actions are difficult to apply when people around them ignore, resist, or refuse to participate in environmental practices.
	1.2 Community resistance and apathy	• "Societal resistance and economic limitations." (S3) • "People don't value the environment." (S64) • "Hard to encourage others." (S75) • "If no one cares about climate change." (S42)	The community's lack of concern, resistance to change, and apathy make environmental initiatives harder to sustain.

		• “Resistance from community members.” (S93)	
2. Limited Resources and Environmental Infrastructure	2.1 Lack of resources or sustainable alternatives	• “Limited resources and access to sustainable alternatives.” (S1, S12) • “Eco-friendly options weren’t always easy to find.” (S10, S35, S50) • “Lack of resources.” (S6, S26, S52) • “Financial constraints limit sustainable choices.” (S19, S75)	Environmental knowledge cannot be practiced consistently when sustainable options are unavailable, inaccessible, or too costly.
	2.2 Lack of proper waste management facilities	• “No proper trash bins or recycling facilities.” (S62, S69) • “Walang sapat na pasilidad para mag-recycle.” (S84) • “Limited facilities for proper waste disposal.” (S83) • “Poor implementation of programs.” (S23)	Participants experience difficulty applying environmental practices due to poor waste segregation systems and lack of community infrastructure.
3. Personal Challenges and Habitual Limitations	3.1 Lack of self-discipline or motivation	• “Lack of self-discipline.” (S77) • “Laziness.” (S90) • “Not following rules and regulations.” (S58) • “Hard to stay consistent.” (S98)	Internal barriers such as discipline, motivation, and personal responsibility impact consistent implementation of environmental practices.
	3.2 Emotional or physical struggles	• “Stress.” (S5) • “Fear to share knowledge.” (S87) • “Cleaning under the heat of the sun... garbage too dirty.” (S86)	Physical discomfort, emotional stress, fear, and unpleasant conditions hinder environmental action.
4. Social Norms, Culture, and Behavioral Resistance	4.1 Culture of convenience	• “Culture of convenience... cost barriers.” (S68) • “Stores still use plastic bags.” (S35)	Convenience-based lifestyles discourage individuals from pursuing eco-friendly actions.
	4.2 Environmental neglect as a social norm	• “People still don’t know how to throw garbage properly.” (S74) • “Saw many people throwing trash.” (S55) • “People around me aren’t practicing the right habits.” (S81)	Neglectful behaviors such as littering and improper waste disposal are normalized in many communities, making environmental action difficult.
	4.3 Community norms that discourage eco-friendly behavior	• “Hard to apply if surroundings don’t care.” (S79) • “People unwilling to change habits.” (S66) • “Dili tanan gyud siya ma-apply...” (S79)	Environmental knowledge is difficult to implement when local culture reinforces unsustainable habits.

The analysis of Table 10 reveals several interconnected themes that illustrate the challenges students face in applying environmental knowledge in real-life contexts.

Lack of Support, Awareness, and Cooperation

Students frequently encountered resistance from peers and the broader community, highlighting that individual environmental efforts are hindered when others are indifferent or uncooperative. Significant statements such as “Many



people didn't care about the environment" (S2) and "Some people weren't interested" (S27, S85) underscore the difficulty of practicing sustainability in a context where communal engagement is low. Sub-themes include lack of cooperation from peers and community and community resistance and apathy, emphasizing that societal indifference, economic limitations, and resistance to environmental initiatives impede students' ability to act on their knowledge. This finding aligns with studies indicating that superficial exposure to technical-scientific environmental concepts without concrete links to daily experience often limits significant learning and application (Quijije et al., 2025). Such a disconnect can cause emotional distress and disinterest among students, particularly when school-promoted environmental actions conflict with prevailing societal or familial values (Huoponen, 2023).

Limited Resources and Environmental Infrastructure

Practical barriers also limit the application of environmental knowledge. Statements like "Eco-friendly options weren't always easy to find" (S10, S35, S50) and "No proper trash bins or recycling facilities" (S62, S69) reflect a scarcity of accessible sustainable alternatives and insufficient waste management systems. The sub-themes—lack of resources or sustainable alternatives and lack of proper waste management facilities—highlight that even motivated students struggle to implement eco-friendly practices when community infrastructure and financial resources are lacking. These structural challenges underscore the importance of addressing systemic issues to facilitate consistent engagement in sustainable behaviors, as behaviors requiring less effort are more easily implemented (Ramadany et al., 2025). This aligns with research indicating that a lack of resources and infrastructure, such as transportation facilities and scientific equipment, can impede hands-on environmental education and practical application (Soomro, 2024).

Personal Challenges and Habitual Limitations

Internal factors such as motivation, discipline, and emotional resilience also affect implementation. Comments like "Laziness" (S90) and "Hard to stay consistent" (S98) illustrate that personal habits and self-discipline are critical in sustaining environmental practices. Additionally, physical and emotional struggles, such as "Cleaning under the heat of the sun... garbage too dirty" (S86), show that environmental action can be physically demanding or emotionally stressful. This

theme reflects that individual commitment is essential but can be undermined by personal and situational constraints. Furthermore, a lack of enthusiasm and perceived self-importance among peers can deter individuals from consistently participating in environmental activities, despite recognizing their importance (Kieu & Singer, 2020). Indeed, the gap between environmental awareness and actionable change often stems from a combination of psychological barriers, including a perceived lack of efficacy and the immediate discomfort associated with altering established routines (Yin et al., 2024; Pataranutaporn et al., 2025).

Social Norms, Culture, and Behavioral Resistance

Cultural habits and prevailing social norms significantly influence environmental behavior. Statements like “Stores still use plastic bags” (S35) and “People still don’t know how to throw garbage properly” (S74) reveal a societal preference for convenience and a normalization of neglectful environmental practices. Sub-themes include culture of convenience, environmental neglect as a social norm, and community norms that discourage eco-friendly behavior, indicating that entrenched cultural and social behaviors can obstruct the translation of environmental knowledge into consistent action. This challenge is exacerbated when pro-environmental actions are met with social disapproval or lack the reinforcing support of immediate social circles, thereby impeding the sustained adoption of such behaviors (Johnson & Činčera, 2015). This resistance to behavioral change is frequently linked to factors such as age and anxiety, where older individuals may exhibit greater reluctance to alter established behaviors, and heightened anxiety can result from increased perceived workload or fear of failure (Massoud et al., 2017).

Overall, these themes demonstrate that students’ ability to apply environmental knowledge is shaped by a complex interplay of social, infrastructural, personal, and cultural factors. While students may possess the knowledge and motivation, systemic barriers and entrenched community behaviors often limit the practical implementation of sustainable practices.

Table 11

Student Experiences on How the Environmental Science Subject Enhanced Environmental Awareness and Action

Main Themes	Sub-themes	Significant Statements	General Description of the Theme
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1. Increased Environmental Awareness and Understanding	1.1 Enhanced understanding of environmental problems	• "It helped me enhance my understanding of environmental challenges." (S3) • "Gave me knowledge on climate change, pollution, biodiversity loss." (S8) • "I learned about environmental problems like deforestation, climate change." (S40, S75) • "Natutunan ko ang mga sanhi at epekto..." (S84)	The subject deepened students' understanding of environmental issues, causes, and consequences, increasing their awareness of global and local problems.
	1.2 Awareness of human impact on the environment	• "The subject taught me the impact of human actions on nature." (S2) • "Made me aware of how my actions affect the environment." (S39, S63, S69) • "Became conscious of daily behavior." (S9, S35)	Students realized how their own habits contribute to environmental degradation and became more conscious of their daily decisions.
	1.3 Recognizing urgency and importance of environmental action	• "It opened my eyes to the urgent need for sustainable practices." (S1) • "Understanding how serious environmental problems are." (S72) • "It gave me a sense of urgency and accountability." (S68)	Students became more aware of the seriousness and urgency of environmental issues, motivating them to pay attention and take action.
2. Motivated Adoption of Eco-Friendly Habits and Actions	2.1 Practice of sustainable habits	• "Became more active in recycling, saving energy." (S1) • "Saving water, recycling." (S10, S27, S50, S61) • "Proper waste segregation." (S62, S83, S69) • "Using less plastic." (S35, S72)	The subject encouraged students to apply sustainable habits in daily life such as recycling, conserving energy, and reducing waste.
	2.2 Participation in environmental activities	• "Joining clean-up drives." (S1, S62, S72) • "Tree planting." (S30, S81) • "Volunteer to conserve and clean up." (S68)	Students became more active in environmental engagements, joining organized clean-up and eco-friendly activities.
	2.3 Taking advocacy roles or inspiring others	• "Advocating for eco-friendly habits in my community." (S1) • "Encouraged to participate in organizations promoting environmental protection." (S20) • "Communication can inspire others." (S83) • "Advocate for sustainable practices." (S93)	Students were empowered to influence others and speak up about environmental care, taking on advocacy roles and inspiring positive change.
3. Development of Responsibility, Discipline, and Environmental Values	3.1 Sense of responsibility as an individual	• "Made me responsible and broadened my mind." (S11) • "Makes me think not to throw garbage anywhere." (S57) • "It helps me become responsible." (S58) • "Reminds me of my responsibility as an individual." (S94)	The subject cultivated a personal sense of responsibility, discipline, and accountability in addressing environmental issues.
	3.2 Valuing nature and protecting the environment	• "Helped me care for nature more." (S35, S44) • "Made me realize the importance of protecting the environment." (S52)	Students developed appreciation and deeper value for the environment, motivating them to protect it.

		• <i>"Nakatulong talaga dahil kailangan ng tao ang environment."</i> (S49)	
	3.3 Behavioral change and attitude shift	• <i>"It became an eye opener for me."</i> (S80) • <i>"Now I'm trying to be more mindful."</i> (S95) • <i>"I now understand how small actions make a big difference."</i> (S85)	Exposure to environmental lessons reshaped the students' attitudes, making them more cautious, reflective, and intentional in their actions.
4. Application of Learning to Real-Life Situations	4.1 Applying lessons to real-life contexts	• <i>"Helped me apply in real life situations."</i> (S86) • <i>"Through real-life issues and examples..."</i> (S47) • <i>"By making discussions into real-life situations."</i> (S67)	Students highlighted how the subject helped them connect environmental concepts to real-life environmental events, making learning meaningful.
	4.2 Increased community involvement	• <i>"Encouraged participation in community activities."</i> (S20, S62) • <i>"Barangay youth encourages responsibility."</i> (S29)	Students became more involved in community-based environmental initiatives.
	4.3 Awareness leading to readiness in facing environmental problems	• <i>"We should be more aware because natural disasters affect our life."</i> (S87) • <i>"Para sa seguridad ng bawat tao."</i> (S43)	Students realized the importance of environmental knowledge for disaster preparedness and community safety.

The analysis of Table 11 shows how the Environmental Science subject enhanced students' environmental awareness and action, organized into four main themes with corresponding sub-themes.

Increased Environmental Awareness and Understanding

Students reported a deeper understanding of environmental problems, recognizing both global and local issues such as climate change, pollution, and biodiversity loss (S3, S8, S40, S75, S84). They also became aware of the impact of human actions on the environment, realizing how daily habits contribute to ecological degradation (S2, S9, S35, S39, S63, S69). Furthermore, the subject fostered recognition of the urgency and importance of taking environmental action, motivating students to be accountable and responsive to pressing environmental challenges (S1, S68, S72). Overall, this theme highlights the subject's role in cultivating knowledge and consciousness regarding environmental issues. This enhanced awareness is crucial, as prior research indicates that while knowledge of environmental problems is necessary, it often falls short of directly translating into behavioral change without further engagement (Mongar, 2023). This indicates a gap between personal values and agentic actions, suggesting that increased awareness alone may not be sufficient to drive substantive changes in behavior



(Guerra et al., 2022).

Motivated Adoption of Eco-Friendly Habits and Actions

The subject encouraged students to integrate sustainable habits into daily life, including recycling, conserving energy, and reducing plastic use (S1, S10, S27, S35, S50, S61, S62, S69, S72, S83). Students also actively participated in environmental activities such as clean-up drives and tree planting (S1, S30, S62, S68, S72, S81), and many took advocacy roles, inspiring others in their communities to adopt eco-friendly practices (S1, S20, S83, S93). This theme reflects the translation of knowledge into concrete, observable actions and leadership in environmental initiatives. Despite this motivation, an attitude-behavior gap can persist, where students express positive environmental attitudes but struggle to translate them into consistent actions, especially when personal effort or cost is involved (Barman, 2023; Gatan et al., 2021; Keramitsoglou et al., 2023). This phenomenon underscores the complexity of fostering pro-environmental behavior, suggesting that intrinsic motivation and perceived self-efficacy play critical roles in bridging this gap (McLaughlin et al., 2018; Kozan et al., 2017).

Development of Responsibility, Discipline, and Environmental Values

Students expressed that the subject strengthened their sense of personal responsibility, accountability, and discipline in addressing environmental issues (S11, S57, S58, S94). They also developed an appreciation for nature and recognized the importance of protecting the environment (S35, S44, S49, S52). Exposure to environmental lessons led to behavioral changes and attitude shifts, making students more mindful and intentional in their actions (S80, S85, S95). This theme emphasizes how the subject shaped values and personal commitment toward sustainability. Such development aligns with studies indicating that direct environmental education fosters a deeper understanding of interconnectedness and stewardship, guiding students' actions regarding environmental issues (Diquito, 2021). However, challenges persist in effectively integrating comprehensive environmental education into curricula globally, often due to a lack of trained teachers and relevant instructional materials (Barman, 2023).

Application of Learning to Real-Life Situations

Students highlighted the relevance of connecting classroom learning to real-world

environmental contexts (S47, S67, S86). They became more involved in community activities and recognized their role in collective environmental responsibility (S20, S29, S62). Additionally, students acknowledged the importance of environmental awareness in preparing for natural disasters and protecting community welfare (S43, S87). This theme demonstrates that the subject not only builds knowledge but also empowers students to apply lessons practically, enhancing both personal and community resilience. This application of knowledge extends beyond individual actions to fostering a collective sense of readiness and proactive engagement with environmental challenges (Sa'adah et al., 2023). Such experiential learning opportunities have been shown to cultivate personal agency and confidence, contributing to a more profound and enduring connection to nature (Gal, 2025).

In summary, the Environmental Science subject strengthened students' environmental awareness, motivated sustainable actions, fostered personal values and responsibility, and enabled practical application of learning, highlighting a comprehensive impact on knowledge, behavior, and community engagement.

Problem 5: What environmental initiative can be developed based on the findings?

Table 12

Project LUNTIAN: Localized Understanding and Nurturing of Transformative Initiatives for Active Nature-stewardship

Component	Description	Expected Outcomes	Key Participants	Sample Indicators
1. Curriculum Integration	Environmental sustainability concepts are embedded in classroom instruction, contextualized with local issues such as coastal management, waste disposal, and climate change impacts in Initao.	Students gain strong academic understanding of environmental issues and their relevance to the community.	• Faculty Members (Environmental Science & related subjects) • Academic Program Chairs • Students	• Lesson plans with ESD integration • Classroom-based projects and assessments with environmental focus
2. Values Formation	Activities foster environmental ethics, personal responsibility, and sustainability as lifelong values.	Students develop environmental stewardship mindset and consistent environment behavior.	• Faculty Members • Guidance Personnel • Students • Campus Ministry / Character Development Units (if applicable)	• Increase in sustainable habits (energy saving, recycling, etc.) • Positive shift in student attitudes (survey-based)



3. Community Participation	Students engage in real-world participation such as mangrove planting, coastal clean-ups, barangay partnerships, recycling campaigns, and local outreach programs.	Students apply learning in the community, helping address local ecological challenges.	• Students • Barangay LGUs • Municipal Environment and Natural Resources Office • Local NGOs and environmental groups • Community volunteers	• Number of community immersion activities • Participation rates • Feedback from barangay officials and partner organizations
4. Student-Led Initiatives	Students conceptualize, organize, and lead environmental projects such as eco-campaigns, recycling drives, and peer education activities.	Students gain leadership experience and stronger environmental ownership.	• Student Organizations (SSG, Program Officers, SRDEC, SRDEO) • Class Officers • Faculty Advisers	• Number of student-led campaigns • Engagement and participation statistics • Documentation of outputs (posters, videos, reports)
5. Institutional Support & Policy Development	Project LUNTIAN becomes institutionalized through policies, budget allocation, recognition, and incorporation into school development plans.	Long-term continuity, institutional memory, and campus-wide sustainability alignment.	• Office of the Vice President for Research, Development & Extension (OVPRDES) • College President and Administrative Council • Finance and Procurement Office • Quality Assurance and Planning Office	• Approved resolutions or memoranda • Official resource allocation • Annual monitoring reports
6. Environmental Literacy Development	Students improve in knowledge, skills, values, and community engagement related to ecological responsibility and resilience.	Students display measurable environmental literacy aligned with sustainability standards.	• Students • Faculty Members • External partners conducting seminars and training	• Improved literacy scores • Demonstrated behavioral change in everyday practices
7. Monitoring and Evaluation	Data-driven review of Project LUNTIAN activities through reflection, surveys, exercises, community feedback, and institutional reporting.	Continuous refinement and adaptation of the program based on findings.	• Research Office • Faculty Evaluators • Student Leaders • Community Partners	• Annual reports and scorecards • Qualitative reflections and assessment tools

Project LUNTIAN, or Localized Understanding and Nurturing of Transformative Initiatives for Active Nature-Stewardship, is a sustainability education and advocacy program designed to institutionalize structured environmental learning within Initao College and its partner communities. Recognizing that environmental learning in many schools remains largely theoretical, the project aims to bridge classroom instruction with real-world application, values formation, and community involvement. The name “LUNTIAN,” meaning green in Filipino, symbolizes ecological renewal, balance, and growth, reflecting the project’s focus on nurturing a culture of environmental responsibility. Project LUNTIAN responds to the

challenges faced by a climate-vulnerable locality such as Initao, including coastal environmental degradation, waste management problems, pollution, and disaster risks, by empowering students to become proactive and environmentally aware citizens equipped with the knowledge, skills, and commitment to protect their surroundings.

Grounded in the principles of Transformative Education for Sustainable Development (TESD), Project LUNTIAN operationalizes UNESCO's call for schools and colleges to contribute meaningfully to the United Nations Sustainable Development Goals (SDGs). It specifically advances SDG 4 (Quality Education) by integrating sustainability into the curriculum and ensuring that students acquire the competencies needed to support sustainable development. Through classroom lessons, interdisciplinary modules, and localized case studies, environmental and sustainability concepts are embedded across academic subjects, enabling students to understand environmental issues within their own community context. The project also supports SDG 13 (Climate Action) by raising awareness and preparing students for climate-responsive action, while SDG 11 (Sustainable Cities and Communities) and SDG 15 (Life on Land) are strengthened through hands-on activities such as tree planting, community environmental brigades, waste management initiatives, and coastal conservation efforts.

A core component of Project LUNTIAN is its emphasis on values formation and behavior change. Beyond teaching concepts, the program seeks to cultivate ecological ethics and a deep sense of personal responsibility, enabling students to adopt sustainable habits in daily life. This is reinforced through guided reflection, structured student activities, and mentorship, helping learners internalize sustainable living not merely as compliance but as part of who they are. Community engagement further reinforces this approach. Students participate in environmental immersion activities in barangays, coastal zones, and public spaces, deepening their understanding of environmental problems and allowing them to participate directly in solving them alongside local stakeholders.

The initiative also highlights student leadership, providing opportunities for learners to design and implement their own environmental projects and campaigns. This fosters empowerment, agency, and civic engagement, qualities



essential for producing future leaders who will continue advancing local sustainability. To ensure long-term continuity, Project LUNTIAN seeks to be institutionalized through policy development, administrative support, resource allocation, and alignment with the college's strategic development plans. This institutionalization ensures systematic monitoring, evaluation, and yearly improvement based on community needs and student outcomes.

Ultimately, Project LUNTIAN aims to enhance student environmental literacy in terms of knowledge, values, skills, and meaningful participation. It supports the college and its surrounding communities in building a culture of sustainability, resilience, and environmental protection aligned with global development agenda. As a localized yet scalable model, Project LUNTIAN demonstrates how higher education institutions can meaningfully contribute to the SDGs by shaping learners who are not only knowledgeable but capable of environmental leadership and transformative action in their own communities.

DISCUSSION

The first table implies that integrating relevant environmental topics, linking lessons to real-life situations, and promoting critical thinking effectively enhance students' understanding of sustainability concepts. This suggests that a well-structured curriculum can bridge theory and practice, preparing students to analyze and address environmental issues thoughtfully. These findings align with prior research emphasizing the importance of incorporating real-world examples and local contexts to enhance environmental education's effectiveness (Scipio et al., 2025). The thematic analysis provided further insights into these quantitative findings, highlighting students' perceptions of the immediate applicability of learned concepts to their daily lives and local communities (Gani et al., 2023). Furthermore, the pedagogical approach in these courses appears to foster a deeper connection between academic content and practical environmental stewardship, a crucial aspect of transformative learning (Biancardi et al., 2023).

Moreover, the second table implies that the subject successfully cultivates environmental responsibility and embeds sustainability into students' personal values. This indicates that values-based education can shape attitudes and ethical behaviors, fostering lifelong commitment to environmental protection. This outcome underscores the transformative potential of environmental education in

cultivating ethical considerations and a sense of stewardship toward the environment, moving beyond mere cognitive understanding to affective and behavioral domains (Misseyanni et al., 2020; Mongar, 2023). Such attitudinal shifts are crucial, as studies have shown that a strong sense of environmental stewardship is fundamental for promoting conservation practices and fostering pro-environmental behaviors (Mongar, 2023).

Additionally, the third table implies that community immersion activities strengthen students' practical knowledge and awareness of local environmental issues. Incorporating fieldwork and service-learning experiences encourages social responsibility and deepens engagement with sustainability initiatives. This approach not only enhances students' understanding of complex environmental challenges but also empowers them to become active participants in addressing these issues within their own localities (Aada, 2024; Dalida et al., 2018). This integration of community-based learning fosters a deeper sense of responsibility and commitment to environmental protection, echoing findings that highlight the significance of practical experience in shaping pro-environmental attitudes (Suwaed, 2024). Such experiential learning is vital for developing environmental accountability and civic responsibility, which are consistently linked to increased student commitment to environmental clean-up and participation programs (Dalida et al., 2018).

Furthermore, the fourth table implies that student-led initiatives develop confidence and participation in environmental advocacy, though opportunities for planning and organizing activities could be enhanced. Providing structured leadership and collaborative projects can empower students to take active roles in promoting sustainable practices. This indicates a potential area for curriculum enhancement to cultivate greater student autonomy and leadership in environmental action (Mongar, 2023). Further promoting these initiatives could leverage the documented effectiveness of localized, hands-on activities in fostering environmental awareness and responsible behavior (Pada et al., 2025; Gosselin et al., 2015). Such efforts are crucial for developing interdisciplinary knowledge and environmental problem-solving skills, which are enhanced through active participation in environmental activities (Hu & Hsin, 2023).

In addition, the fifth table implies that the Environmental Science subject effectively



builds students' environmental knowledge and awareness, enhancing their ability to understand ecological issues and the human impact on the environment. This suggests that a strong focus on knowledge acquisition is essential for fostering informed and conscious decision-making in sustainability. This robust understanding indicates a solid foundation for translating knowledge into tangible pro-environmental behaviors, although educational interventions often need to bridge the gap between strong attitudes and consistent application in daily habits (Ramadany et al., 2025). For instance, while students demonstrate an excellent understanding of sustainability principles such as energy conservation and pollution reduction, the curriculum must explicitly analyze whether this conceptual grasp translates into practical skills and real-world application (Ramadany et al., 2025). This transition from theoretical knowledge to applied behavior is critical, as mere awareness often fails to translate into action without sustained reinforcement and opportunities for practical engagement (Telesford et al., 2024; Gatan et al., 2021). The implementation of hands-on activities and direct exposure to environmental issues can significantly bolster students' ability to apply their classroom knowledge to real-world sustainability challenges (Malaluan et al., 2022; Gani et al., 2023).

Also, the sixth table implies that students are able to translate environmental knowledge into practical skills and daily eco-friendly practices, such as waste segregation, energy conservation, and sustainable choices. This highlights the importance of integrating skill-based learning to encourage consistent environmentally responsible behaviors. This empirical evidence aligns with previous research highlighting that environmental education not only enhances understanding but also encourages changes in pro-environmental behavior (Husamah et al., 2025). For example, studies have shown that learners who receive environmental education demonstrate an increased capability to reduce and recycle waste, ultimately channeling these skills into citizen science projects and influencing local environmental policies (Mendoza, 2023). This includes a demonstrated ability to separate waste for recycling, conserve water and electricity, and utilize public transportation, all crucial green skills for future sustainable development (Dlimbetova 2023; Kamis et al., 2018). This indicates that pedagogical approaches effectively connect theoretical learning with practical application, leading to a demonstrable acquisition of green skills among students (Mahapatra & Ravichandran, 2023).

Consequently, the seventh table implies that the subject cultivates positive environmental attitudes, a sense of personal responsibility, and pride in sustainability-focused education. This indicates that fostering pro-environmental values is critical in motivating students to maintain long-term commitment to ecological care. This cultivation of positive attitudes is crucial, as emotional well-being and hopefulness are often overlooked in traditional environmental education but are vital for fostering sustained engagement and commitment to environmental issues (Bercasio & Remolacio, 2022). This aligns with research indicating that enhanced environmental awareness, often fostered through comprehensive educational programs, correlates with an increased desire to mitigate environmental harm and participate in conservation activities (Punatung & Kurukodt, 2023). Furthermore, these programs help students develop a strong sense of environmental consciousness and a willingness to volunteer for environmental protection initiatives (Magulod, 2018).

Moreover, the eighth table implies that students actively apply their environmental knowledge beyond the classroom through sharing information, volunteering, and supporting sustainability initiatives. This suggests that promoting community engagement strengthens students' social responsibility and amplifies the impact of environmental education in the broader community. This emphasizes the subject's role in cultivating a sense of collective responsibility and empowering students to become active environmental stewards within their local contexts (Anggraini et al., 2024; Dalida et al., 2018). Such findings are consistent with studies demonstrating that university students actively support research and community-based programs focused on sustainable development and climate change mitigation (Bastida, 2023). These observations underscore the critical role of environmental education in cultivating not only individual ecological awareness but also collective action and community-level environmental stewardship (Gani et al., 2023).

Ultimately, the ninth table implies that students' experiences of transformative education are strongly and positively associated with their environmental literacy and resilience. This suggests that engaging students in well-rounded transformative learning—through curriculum integration, values formation, community immersion, and student-led initiatives—effectively enhances their



knowledge, skills, attitudes, and community involvement in sustainability. The notable correlation between student-led initiatives and heightened environmental literacy further emphasizes the efficacy of experiential learning in cultivating profound environmental understanding and resilience (Dlimbetova, 2023). This strong relationship implies that pedagogical approaches emphasizing active student participation and real-world application effectively bridge theoretical knowledge and practical environmental stewardship (Bastida, 2023). This aligns with studies indicating that pro-environmental attitudes and participation in environmental decision-making are significantly enhanced through educational programs (Barman, 2023). These findings are also consistent with research highlighting the importance of environmental literacy in promoting action competence for sustainability among students (Husamah et al., 2025) and the role of higher education in fostering comprehensive environmental literacy for future leaders (Ariyatun et al., 2024). Moreover, previous research has indicated a strong positive correlation between environmental literacy and action competence for sustainability, suggesting that increased environmental understanding directly leads to greater engagement in pro-environmental actions (Husamah et al., 2025).

The tenth table implies that students face multiple challenges in applying environmental knowledge in real-life settings, including lack of support and cooperation from peers and the community, limited resources and infrastructure, personal habits and motivational barriers, and prevailing social norms that discourage eco-friendly behavior. This suggests that while knowledge and awareness are essential, effective environmental education must also address external and internal barriers by fostering community engagement, improving infrastructure, supporting behavioral change, and promoting a culture that values sustainability to ensure that learning translates into meaningful action. Also, the eleventh table implies that the Environmental Science subject significantly increased students' environmental awareness, motivated eco-friendly habits, developed responsibility and values, and facilitated the application of learning to real-life situations. This indicates that combining knowledge, practical activities, advocacy, and real-world connections fosters meaningful learning experiences that translate into sustained environmental action and community engagement.

In conclusion, the findings of this study demonstrate that Transformative Education for Sustainable Development (TESD) effectively enhances the environmental

literacy and resilience of students at Initao College by integrating sustainability principles into the curriculum, community engagement activities, values-based learning, and student-led initiatives. Students not only gained substantial knowledge on environmental issues but also developed strong ecological values, practical green skills, and an increased willingness to participate in community and environmental advocacy. The strong positive correlations between TESD components and student outcomes confirm that transformative learning approaches—particularly experiential and collaborative activities—foster meaningful application of classroom concepts to real-life environmental challenges. However, despite these gains, students continue to face barriers such as limited community participation, inadequate environmental infrastructure, and prevailing cultural norms that discourage sustainable behavior, highlighting the need for broader systemic and socio-cultural support to sustain environmental action beyond the academic setting.

In light of the study's findings, it is recommended that Initao College may formally institutionalize Project LUNTIAN to ensure continuity and long-term impact of sustainability initiatives. This may include integrating TESD across more academic programs, allocating dedicated resources for environmental initiatives, and strengthening partnerships with barangays, LGUs, NGOs, and environmental agencies to expand support networks for community-based projects. Continuous professional development for faculty should also be provided to enhance their capacity for transformative sustainability teaching and experiential learning facilitation. Additionally, improved campus infrastructure such as recycling facilities, green spaces, and environmental communication systems should be developed to reinforce sustainable practices. Finally, ongoing monitoring and evaluation of TESD implementation should be conducted to document progress, identify gaps, and inform data-driven improvements that further empower students to become effective environmental stewards and agents of transformative community change.

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