



The Mediating Role of Locus of Control in the Relationship between Environmental Education and Pro-Environmental Behavior among University Students

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Abstract

Aims. This study investigates the relationship between environmental education and pro-environmental behavior among university students, with locus of control as a mediating variable. Environmental education is believed to enhance awareness and values related to sustainability, yet its effectiveness may depend on individuals' perceived control over their actions.

Methods. The study involved 200 students from various academic programs who had taken environmental courses. Partial Least Squares Structural Equation Modeling (PLS-SEM) was employed for data analysis.

Result. The results show that environmental education positively influences pro-environmental behavior, and locus of control significantly mediates this relationship.

Conclusion. Students with an internal locus of control are more likely to translate environmental knowledge into actionable behavior.

Implementation. The study suggests that educational strategies should emphasize the development of personal agency in environmental matters to support behavioral change.

Keywords: Environmental education; pro-environmental behavior; locus of control



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INTRODUCTION

Climate change, environmental degradation, and the depletion of natural resources have emerged as global challenges demanding serious attention from all levels of society (Maja & Ayano, 2021). Amid these complex environmental issues, education plays a strategic role in shaping awareness and pro-environmental behavior, particularly among young people (Mendes et al., 2025). Universities, as centers of higher learning, serve not only as venues for knowledge

transfer but also as arenas for cultivating values, attitudes, and competencies that encourage individuals to actively contribute to environmental preservation (Pee & Vululleh, 2023). Emphasizing effective environmental education has become a primary strategy for fostering environmentally responsible behavior (Miao & Nduneseokwu, 2025).

Environmental education goes beyond merely providing information about ecological conditions; it instills a deep understanding of the impacts of human actions on ecosystem balance (Bosa & Sarach, 2019). Systematically designed learning processes can influence students' perceptions, attitudes, and motivations to participate in activities that support sustainability (Michilena et al., 2023). Previous studies suggest that consistent exposure to environmental education can enhance ecological awareness, facilitate the internalization of sustainability values, and encourage engagement in tangible pro-environmental actions (Chang & Cao, 2025). However, the effectiveness of environmental education is not always uniform, as its influence is often moderated or mediated by individual psychological factors (Begum et al., 2021).

One psychological factor with substantial potential to mediate the relationship between environmental education and pro-environmental behavior is locus of control. Locus of control refers to an individual's belief regarding the extent to which they can control the outcomes of their actions (Akzen, 2002). Students with an internal locus of control tend to believe that their personal efforts can produce tangible effects, whereas individuals with an external locus of control may perceive outcomes as dependent on external forces such as fate, policy, or the influence of others (Galvin et al., 2018). This distinction has significant implications for the effectiveness of environmental education in translating into pro-environmental behavior.

Integrating the concept of locus of control into environmental education offers a more nuanced perspective on behavioral change mechanisms (Yang & Weber, 2019). Students who receive environmental education but possess an external locus of control may be less motivated to consistently implement sustainable behaviors, even if they understand the urgency of ecological issues (Cleveland et al., 2020). Conversely, those with an internal locus of control are more likely to respond positively to educational content, apply sustainability principles in daily life, and proactively influence their surrounding environment (Rahmawati et al., 2023). Therefore, understanding the mediating role of locus of control is essential for optimizing environmental education programs in higher education.

Moreover, the university context provides unique opportunities to explore this relationship, as students are at a critical stage of cognitive and social development (Osher et

al., 2020). They have the capacity for self-reflection, complex decision-making, and the formation of enduring value identities. Factors such as learning experiences, social interactions, and exposure to campus environmental initiatives can either strengthen or weaken the effect of environmental education on actual behavior (Varela et al., 2018). Consequently, this study emphasizes the need for a multidimensional approach that considers cognitive, motivational, and psychological aspects of students.

Previous research has highlighted the positive relationship between environmental education and pro-environmental behavior (Yang et al., 2021; Estrada-Araoz, 2023; Si et al., 2022; Wu et al., 2025), yet most studies focus primarily on direct effects without addressing the underlying psychological mediation mechanisms. Meanwhile, studies on locus of control indicate its potential in predicting adaptive behavior, responsible decision-making, and intrinsic motivation (Afrar et al., 2023; Yan, 20224; Tyler et al., 2020); however, its application in the context of environmental behavior remains relatively limited. This gap highlights the importance of investigating how locus of control may bridge the influence of environmental education on students' pro-environmental actions.

Based on these considerations, this study aims to examine the mediating role of locus of control in the relationship between environmental education and pro-environmental behavior among university students. The primary research questions are: Does environmental education influence students' pro-environmental behavior, and to what extent does locus of control mediate this relationship? Addressing these questions is expected to provide deeper insights into the psychological factors affecting the effectiveness of environmental education and to offer practical implications for curriculum development and educational strategies that promote sustainable behavior in higher education.

LITERATURE REVIEW

Despite the growing literature on environmental education and sustainability behavior, several critical gaps remain:

1. **Limited Exploration of Mediating Variables.** Most previous studies focus on direct relationships, neglecting the underlying psychological mechanisms that explain how and why environmental education influences behavior.
2. **Underutilization of Locus of Control in Environmental Contexts.** While locus of control is well-established in the behavioral sciences, its role as a mediator in environmental

education–behavior relationships remains insufficiently studied and lacks empirical confirmation.

3. Overemphasis on Cognitive Outcomes. Existing research tends to prioritize knowledge and awareness, with less attention to personal agency and motivational constructs, which are crucial for actual behavioral change.
4. Lack of Integrated Behavioral Models in Higher Education. Few studies develop comprehensive models that combine educational, psychological, and behavioral dimensions within university settings.
5. Methodological Limitations in Prior Studies. Many earlier studies rely on simplistic analytical approaches, limiting the ability to capture complex inter-variable relationships, particularly mediation effects.
6. Contextual Limitations. There is a scarcity of research focusing on developing country contexts, especially in Southeast Asia, where socio-cultural and educational dynamics may influence environmental behavior differently.

Research Framework and Hypothesis

This study examines the mediating role of locus of control in the relationship between environmental education and pro-environmental behavior among university students. Environmental education provides knowledge, skills, and values that encourage sustainable practices, while pro-environmental behavior reflects actions that reduce environmental impact. Locus of control represents students’ beliefs about their ability to influence outcomes, with internal locus of control expected to enhance the translation of knowledge into action. The framework proposes that environmental education not only directly promotes pro-environmental behavior but also indirectly influences it through strengthening the internal locus of control (see Figure 1).

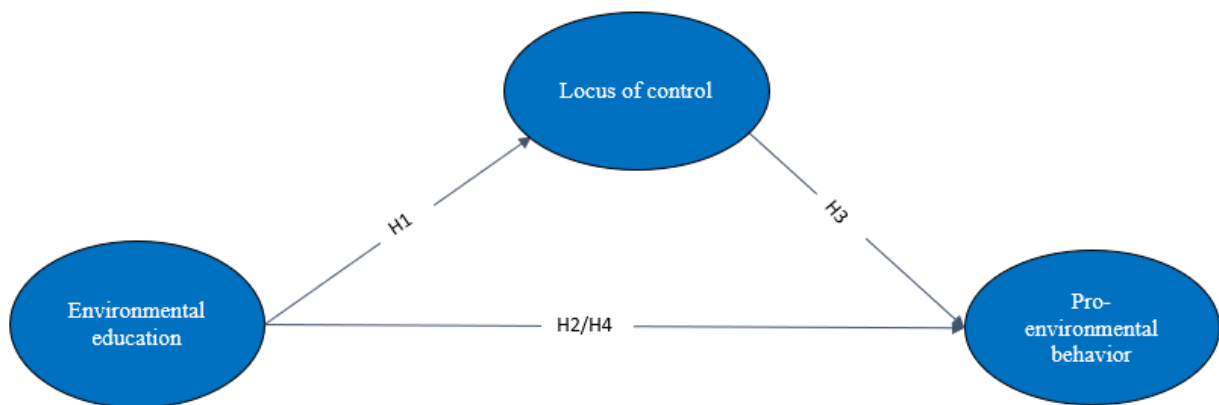


Figure 1. Study framework

Based on the study framework, the study proposes the following hypotheses:

H1: Environmental education has a positive effect on students' internal locus of control.

H2: Environmental education has a positive direct effect on pro-environmental behavior.

H3: Locus of control positively influences pro-environmental behavior among university students.

H4: Locus of control mediates the relationship between environmental education and pro-environmental behavior.

Recent scholarly discourse has consistently emphasized the pivotal role of environmental education in fostering pro-environmental behavior, particularly within higher education contexts. Empirical studies demonstrate that structured environmental learning enhances ecological awareness, sustainability values, and behavioral intentions among students. Prior research (e.g., Varela-Candamio et al., 2018; Estrada-Araoz et al., 2023; Wu et al., 2025) largely confirms a direct positive relationship between environmental education and pro-environmental behavior. However, contemporary literature has begun to shift toward more complex behavioral models, integrating psychological constructs to better explain how knowledge translates into action. Constructs such as self-efficacy, environmental attitudes, and social norms have been explored as mediators in sustainability-related behaviors (Zhang & Cao, 2025). Within this stream, locus of control emerges as a critical psychological factor influencing individuals' perception of agency and responsibility. Although locus of control has been widely examined in psychology and behavioral studies (Galvin et al., 2018; Tyler et al., 2020), its application in environmental education remains relatively underexplored. Existing studies suggest that individuals with an internal locus of control are more likely to engage in proactive and responsible behaviors, including sustainability practices (Cleveland et al., 2020). Nonetheless, the integration of locus of control into environmental education frameworks is still limited and lacks empirical depth. Thus, the current state of the art reflects a transition from knowledge-based models toward psychologically enriched frameworks, yet still requires further empirical validation, particularly in educational settings.

METHODS

Research Design

This study employs a quantitative, cross-sectional design to examine the relationships between environmental education, locus of control, and pro-environmental behavior among university students. A mediational analysis approach is used to test whether locus of control

mediates the effect of environmental education on pro-environmental behavior. Data are collected through structured questionnaires and analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM).

Participants and Sampling

The research population consists of undergraduate students enrolled at selected universities in Jakarta. A stratified random sampling method is applied to ensure representation across faculties and study programs. Inclusion criteria include students who have been exposed to formal or informal environmental education activities, while participants with incomplete responses are excluded. Sample size is determined based on PLS-SEM guidelines to ensure statistical power.

Measures and Instrumentation

The study uses validated questionnaires to measure the three key constructs:

- **Environmental Education:** Assessed through items capturing exposure to environmental content, participation in sustainability programs, and understanding of human impact on the environment (Law et al., 2017).
- **Locus of Control:** Measured using scales adapted from Rotter's Locus of Control framework, distinguishing internal versus external control beliefs (Nowicki & Duke, 2017).
- **Pro-Environmental Behavior:** Evaluated through self-reported frequency of actions such as recycling, energy conservation, and participation in environmental campaigns (Cleveland et al., 2020).

All items use a Likert-type scale to quantify responses, and reliability and validity are tested prior to analysis.

Data Collection Procedure

Data collection is conducted via online and/or paper-based surveys, ensuring anonymity and voluntary participation. Informed consent is obtained from all participants, and ethical guidelines are strictly followed. Surveys are distributed over a predefined period, with follow-up reminders to maximize response rates. Collected data are then screened for completeness and consistency before analysis.

Data Analysis

Data analysis involves two stages: measurement model assessment and structural model testing using PLS-SEM. The measurement model evaluates construct reliability, convergent validity, and discriminant validity (Hair et al., 2014). The structural model examines direct effects of environmental education on pro-environmental behavior, the effect of environmental education on locus of control, the effect of locus of control on behavior, and the mediating role of locus of control. Bootstrapping is applied to test the significance of hypothesized paths.

DISCUSSION

Validity and reliability

The results of the confirmatory factor analysis indicate that all constructs demonstrate strong measurement properties (see Table 1). For Environmental Education, the outer loadings of all indicators range from 0.856 to 0.916, while reliability measures are high, with Cronbach's alpha ($\alpha = 0.928$), rho_A (0.930), and composite reliability (CR = 0.945), supporting internal consistency. The average variance extracted (AVE = 0.776) exceeds the recommended threshold of 0.50, indicating adequate convergent validity. Similarly, Locus of Control exhibits robust psychometric properties, with outer loadings between 0.858 and 0.939, $\alpha = 0.945$, rho_A = 0.946, CR = 0.958, and AVE = 0.822, confirming that the items consistently represent the underlying construct.

The construct Pro-Environmental Behavior also shows strong validity and reliability, with indicator loadings ranging from 0.849 to 0.940, $\alpha = 0.941$, rho_A = 0.942, CR = 0.955, and AVE = 0.809. These results suggest that all items are appropriate measures of their respective constructs and capture substantial variance. Overall, the CFA results provide sufficient evidence that the measurement model is both reliable and valid, ensuring that subsequent structural analyses can be interpreted with confidence.

Table 1. Confirmatory factor analysis

Construct	Indicators	Outer Loading	α	rho_A	CR	AVE
Environmental education	1. EE1: Exposure to environmental content in campus learning activities.	0.856	0.928	0.93	0.945	0.776
	2. EE2: Lecturers regularly explain the importance of environmental protection.	0.916				
	3. EE3: Participation in campus activities with an environmental theme (e.g., tree planting, recycling).	0.901				
	4. EE4: Environmental education materials are engaging and easy to understand.	0.869				
	5. EE5: Understanding the impact of human behavior on the environment through formal learning.	0.861				
Locus of control	1. LOC1: I believe that personal effort can produce tangible change.	0.924	0.945	0.946	0.958	0.822
	2. LOC2: My success depends on my own actions and decisions.	0.907				
	3. LOC3: I am responsible for the consequences of my actions.	0.858				
	4. LOC4: I believe I can influence my surrounding environment through personal actions.	0.903				
	5. LOC5: I tend to take initiative rather than wait for others to act.	0.939				
Pro-environmental behavior	1. PEB1: Reducing energy consumption (e.g., turning off lights or electrical devices).	0.919	0.941	0.942	0.955	0.809
	2. PEB2: Participating in recycling or waste management programs.	0.940				
	3. PEB3: Reducing the use of single-use plastics.	0.880				
	4. PEB4: Engaging in campus or community environmental activities.	0.849				
	5. PEB5: Making daily decisions considering their environmental impact.	0.908				

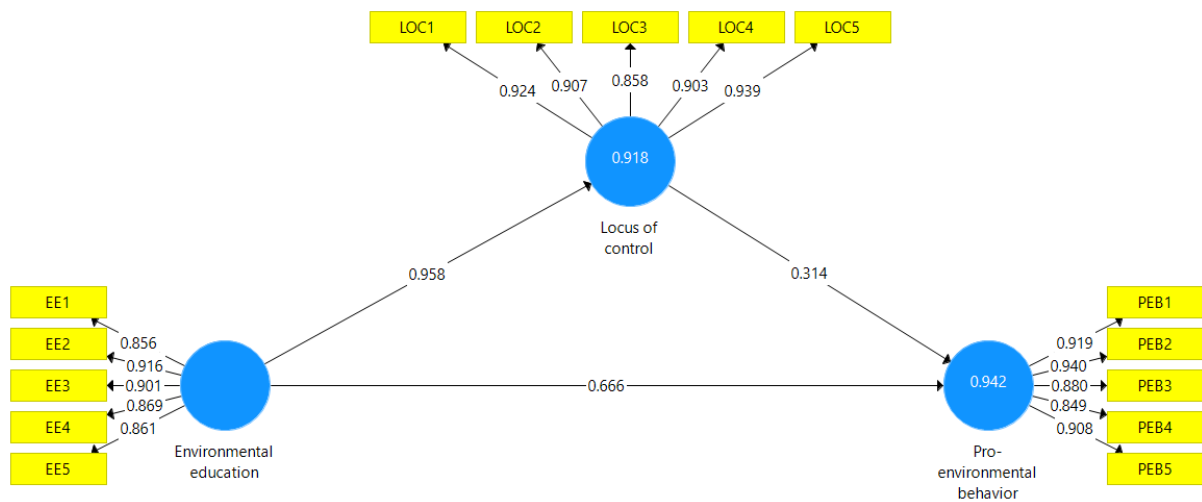


Figure 2. PLS-SEM algorithm

The discriminant validity of the measurement model was evaluated using both the Fornell-Larcker criterion and the HTMT ratio. According to the Fornell-Larcker criterion (see Table 2), the square roots of the AVE for each construct exceed the inter-construct correlations. For instance, Environmental Education shows an AVE square root of 0.881, which is higher than its correlations with Locus of Control (0.958) and Pro-Environmental Behavior (0.966). Similarly, Locus of Control (0.906) and Pro-Environmental Behavior (0.900) meet the criterion, indicating that each construct explains more variance in its indicators than in other constructs, thereby supporting discriminant validity.

Complementary evidence from the HTMT ratio (see Table 3) further confirms discriminant validity. All HTMT values are below the conservative threshold of 0.85, with values of 0.822 between EE and LOC, 0.805 between LOC and PEB, and 0.731 between EE and PEB. These findings suggest that the constructs are empirically distinct and that multicollinearity or redundancy between constructs is minimal, ensuring that the measurement model is suitable for subsequent structural analysis.

Table 2. Fornell-Larcker criterion

Construct	EE	LOC	PEB
Environmental education	0.881		
Locus of control	0.958	0.906	
Pro-environmental behavior	0.966	0.952	0.900

Table 3. HTMT ratio

Construct	EE	LOC	PEB
Environmental education	-		
Locus of control	0.822	-	
Pro-environmental behavior	0.731	0.805	-

Structural model assessment

The structural model assessment demonstrates strong explanatory and predictive capabilities of the proposed framework. As shown in Table 4, the R-square values indicate that Environmental Education explains a substantial portion of the variance in Locus of Control ($R^2 = 0.918$) and, together with Locus of Control, in Pro-Environmental Behavior ($R^2 = 0.942$). Both adjusted R-squared values remain similarly high, confirming that the model possesses strong predictive power for both endogenous constructs.

Effect size evaluation in Table 5 reveals that Environmental Education has a large effect on both Locus of Control ($f^2 = 11.27$) and Pro-Environmental Behavior ($f^2 = 0.619$), indicating its substantial contribution to explaining variance in these outcomes. Locus of Control exerts a small effect on Pro-Environmental Behavior ($f^2 = 0.137$), suggesting that, while it plays a mediating role, its incremental explanatory power is modest. Moreover, predictive relevance, assessed via the Q^2 statistic in Table 6, shows Q^2 values of 0.749 for Locus of Control and 0.751 for Pro-Environmental Behavior, further confirming strong predictive relevance and indicating that the model reliably anticipates data points not used in estimation.

Table 4. R-square result

Construct	R Square	R Square Adjusted	Result
Locus of control	0.918	0.918	Strong predictive power
Pro-environmental behavior	0.942	0.941	Strong predictive power

Table 5. F-square result

Construct	LOC	PEB	Result
Environmental education	11.27	0.619	Large effect (on LOC) Large effect (on PEB)
Locus of control		0.137	Small effect (on PEB)

Table 6. Q-square result

Construct	SSO	SSE	Q ² (=1-SSE/SSO)	Result
Locus of control	1000	251.114	0.749	Strong predictive relevance
Pro-environmental behavior	1000	249.065	0.751	Strong predictive relevance

Hypothesis result

The hypothesis testing results in Table 7 and Figure 3 indicate that all proposed relationships are statistically significant and supported. H1 demonstrates a strong positive effect of Environmental Education on Locus of Control ($\beta = 0.958, t = 83.387, p < 0.001$), confirming that exposure to environmental education substantially enhances students’ beliefs in their personal ability to influence outcomes. H2 shows that Environmental Education also directly influences Pro-Environmental Behavior ($\beta = 0.666, t = 8.708, p < 0.001$), suggesting that educational interventions effectively translate into observable sustainable actions.

The effect of Locus of Control on Pro-Environmental Behavior (H3) is positive and significant ($\beta = 0.314, t = 3.980, p < 0.001$), indicating that students with higher internal locus of control are more likely to engage in pro-environmental actions. Importantly, the mediating role of Locus of Control (H4) is supported ($\beta = 0.301, t = 3.977, p < 0.001$), demonstrating that part of the influence of Environmental Education on Pro-Environmental Behavior operates through its effect on students’ locus of control. Overall, these findings confirm both the direct and indirect pathways hypothesized in the model.

Table 7. Hypothesis result

Hypothesis	Construct*)	β	Bias	Confidence Intervals		T Statistics	P Values	Result
				2.50%	97.50%			
H1	EE -> LOC	0.958	-0.001	0.930	0.977	83.387	0.000	Accepted
H2	EE -> PEB	0.666	0.000	0.514	0.826	8.708	0.000	Accepted
H3	LOC-> PEB	0.314	0.000	0.143	0.466	3.98	0.000	Accepted
H4	EE -> LOC -> PEB	0.301	0.000	0.138	0.449	3.977	0.000	Accepted

Abbreviation: EE=Environmental education; LOC=Locus of control; PEB=Pro-environmental behavior

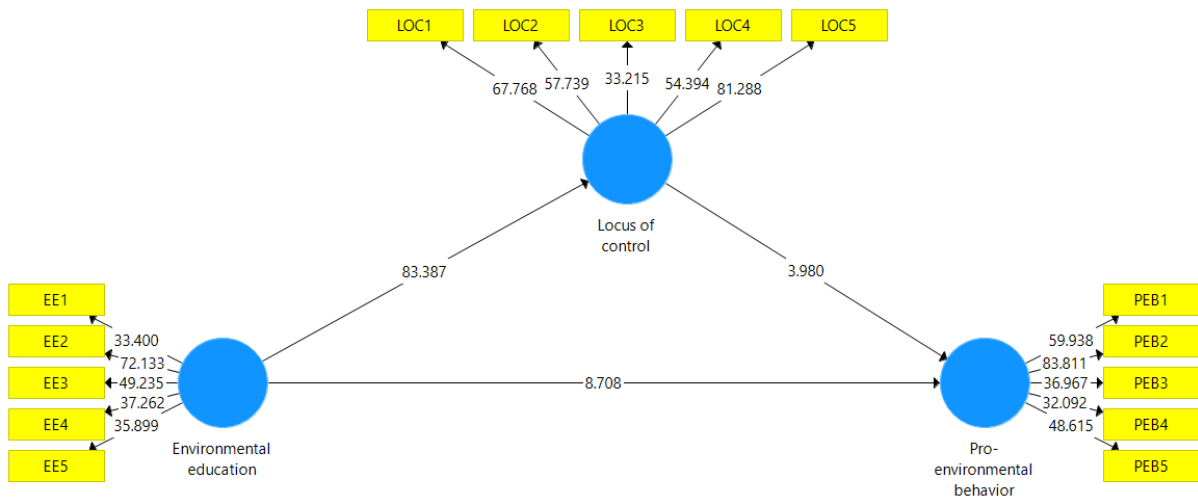


Figure 3. PLS-SEM model result

The results for H1 indicate that Environmental Education has a strong and positive effect on students’ internal locus of control. This finding suggests that exposure to structured environmental content, participation in sustainability programs, and engagement with ecological learning materials significantly enhance students’ belief in their personal capacity to influence outcomes. This aligns with prior research demonstrating that educational interventions can cultivate a sense of personal agency and self-efficacy, which are core components of an internal locus of control (tyler et al., 2020; Papoulidi & Maniadaki, 2025). By consistently integrating environmental knowledge with practical applications, students perceive their actions as meaningful and capable of producing tangible results, reinforcing proactive behavioral tendencies.

H2 reveals that Environmental Education also directly influences pro-environmental behavior. This finding underscores the effectiveness of environmental education in translating awareness and knowledge into concrete sustainable actions. Prior studies have similarly reported that curriculum-based exposure to ecological content, alongside experiential learning such as campus sustainability projects, can increase the frequency of behaviors like recycling, energy conservation, and responsible consumption (Tomaasella et al., 2022; Ganatsios, 2024). These results suggest that educational programs are not limited to theoretical knowledge but serve as a practical foundation for fostering environmentally responsible lifestyles among university students.

Regarding H3, the effect of Locus of Control on pro-environmental behavior is positive and significant. This indicates that students with a higher internal locus of control are more likely to translate their environmental awareness into actionable behaviors. This is consistent

with literature emphasizing that individuals who perceive greater personal control over outcomes are more proactive, persistent, and motivated in pursuing sustainable practices (Chan et al., 2022). In the university context, students who believe their efforts matter are more inclined to participate in environmental campaigns, adopt green routines, and advocate for ecological initiatives within their communities.

The mediating role of Locus of Control, as proposed in H4, is also supported, demonstrating that part of the influence of Environmental Education on pro-environmental behavior operates through its effect on students' locus of control. This finding highlights the psychological mechanism underpinning behavioral adoption: while educational content provides knowledge, the internalization of control beliefs empowers students to act on that knowledge. Similar mediating effects have been reported in prior studies exploring self-efficacy and personal agency as bridges between educational interventions and pro-environmental behaviors (Koskela & Paloniemi, 2023).

The magnitude of the effect of Environmental Education on Locus of Control observed in this study suggests that well-structured educational programs can substantially reinforce students' perception of personal influence. This implies that environmental curricula should not only deliver content but also incorporate opportunities for reflection, decision-making, and hands-on engagement that allow students to experience the consequences of their actions. By doing so, educational strategies can strengthen internal locus of control, which serves as a catalyst for sustained behavioral change.

Although Locus of Control shows a smaller effect on pro-environmental behavior compared to the direct influence of Environmental Education, its mediating role is crucial in shaping the pathway through which knowledge translates into action. This finding is supported by previous evidence indicating that internal control beliefs increase motivation to adopt and maintain environmentally responsible behaviors, even under challenging or uncertain conditions (Afsar et al., 2020). Therefore, the combination of knowledge acquisition and psychological empowerment appears to be essential for promoting meaningful, long-term behavioral outcomes.

These findings collectively emphasize the dual importance of content and cognition in environmental education. While knowledge about environmental issues initiates awareness, the enhancement of internal locus of control ensures that students perceive themselves as capable actors in addressing ecological challenges. This integration aligns with contemporary educational paradigms that advocate experiential and transformative learning, in which

students are both informed and psychologically equipped to implement sustainable practices (Lange, 2019).

In conclusion, the results of this study confirm the hypothesized relationships, illustrating that Environmental Education not only directly promotes pro-environmental behavior but also exerts an indirect effect through Locus of Control. These findings reinforce the need for universities to design curricula and extracurricular activities that simultaneously build knowledge, skills, and internal control beliefs. Future research may expand on these results by exploring other psychological or contextual mediators, such as environmental values or social norms, to further understand the mechanisms driving sustainable behavior in higher education settings.

This study offers several significant contributions that extend the existing body of knowledge:

1. **Integration of Psychological Mediation Mechanism.** Unlike prior studies that predominantly examine direct effects, this research introduces locus of control as a mediating variable, providing a deeper understanding of the psychological pathway linking environmental education and behavior.
2. **Focus on Internal Locus of Control as Behavioral Catalyst.** The study highlights the role of internal locus of control as a key driver that transforms environmental knowledge into actionable behavior, emphasizing personal agency rather than mere awareness.
3. **Application in Higher Education Context.** By focusing on university students, the research situates environmental behavior within a developmentally critical population in which values, cognition, and long-term behavioral patterns are actively formed.
4. **Empirical Validation Using PLS-SEM.** The use of Partial Least Squares Structural Equation Modeling (PLS-SEM) strengthens the model's robustness, offering strong predictive and explanatory power for both direct and indirect relationships.
5. **Dual-Pathway Model (Direct and Indirect Effects).** The study proposes and validates a dual mechanism: Direct effect: Environmental education → Pro-environmental behavior; Indirect effect: Environmental education → Locus of control → Behavior

This integrative approach provides a more holistic and nuanced explanation of the formation of sustainable behavior.

In summary, the study addresses a critical gap by moving beyond traditional direct-effect models and proposing a psychologically grounded framework. By positioning locus of control as a mediating mechanism, this research advances the theoretical understanding of how

environmental education translates into sustainable behavior, offering both theoretical enrichment and practical implications for curriculum design and policy development.

CONCLUSIONS

This study provides empirical evidence that Environmental Education plays a significant role in shaping university students' pro-environmental behavior. The findings demonstrate that exposure to environmental knowledge, participation in sustainability programs, and engagement with ecological learning materials not only enhance awareness but also directly encourage students to adopt sustainable practices. These results underscore the importance of integrating both theoretical and experiential environmental education within higher education curricula to foster actionable ecological responsibility.

The analysis also confirms the critical role of Locus of Control as both an outcome of Environmental Education and a mediator influencing pro-environmental behavior. Students with a higher internal locus of control perceive their actions as meaningful and impactful, which increases their likelihood of engaging in sustainable behaviors. This mediating effect highlights the psychological mechanism through which educational interventions translate knowledge into behavior, emphasizing that fostering personal agency is as important as delivering content.

The practical implications of this study suggest that universities should design curricula and extracurricular programs that simultaneously provide environmental knowledge and strengthen students' sense of personal agency. By creating learning experiences that allow students to witness the outcomes of their actions, educators can enhance both the cognitive and psychological drivers of sustainable behavior. Policymakers and curriculum designers can leverage these insights to develop interventions that are not only informative but also empowering, thereby producing graduates capable of contributing effectively to environmental sustainability.

Despite its contributions, this study has several limitations. The cross-sectional design restricts the ability to establish causal relationships, and the reliance on self-reported measures may introduce response bias. Additionally, the sample was limited to university students from selected institutions, which may affect the generalizability of the findings to other populations or educational contexts. Future research could employ longitudinal designs, include diverse student populations, and explore additional mediating or moderating factors such as

environmental values, social norms, or institutional support to provide a more comprehensive understanding of the mechanisms driving pro-environmental behavior.

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