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An Analytical Study of Science Students' Attitudes Toward Environmental Conservation Issues and Actions

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Abstract

This study aims to analyze science students' attitudes toward environmental conservation issues and actions, with a focus on understanding personal commitment, emotional engagement, conservative values, and appreciation for environmental education. Employing a mixed-methods approach, quantitative data were obtained from 43 students through a five-point Likert-scale attitude questionnaire, while qualitative data were collected through in-depth interviews with six selected respondents. Quantitative analysis revealed an average attitude score of 24.56, categorized as "Low", with the majority of respondents (55.81%) showing a weak level of concern toward environmental conservation issues. No respondents fell into the "Very Good" category, and only 6.98% were classified as "Good". The qualitative analysis indicated that, although students expressed normative awareness of the importance of conservation, their involvement remained situational, influenced by social context, and constrained by academic pressure and limited community support. The findings emphasize the need for reform in environmental education at the university level, particularly in integrating affective dimensions, personal values, and psychosocial empowerment. The implications highlight the importance of a transformative and participatory curriculum to foster strong and sustainable pro-environmental attitudes among science students.

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INTRODUCTION

Environmental degradation has become an increasingly urgent global concern, with tangible impacts occurring across various regions, including Indonesia. The country is facing highly complex ecological pressures, ranging from pollution and climate change to deforestation and biodiversity crises that threaten the sustainability of natural systems. Numerous studies have indicated that chemical pollution—particularly from heavy metals and hazardous compounds—has triggered oxidative stress in multiple ecosystem components, negatively affecting biodiversity and reducing ecosystem services such as soil

fertility and clean water availability (Cristiano et al., 2021; Sigmund et al., 2023). This situation is further exacerbated by the close interrelation between pollution and climate change, which together impair the environment's ability to maintain its ecological functions (Zhang, 2019).

Climate change itself imposes significant additional pressure on biodiversity. Global temperature shifts, erratic rainfall patterns, and extreme weather events have influenced the distribution and survival of various species. Moreover, the increased atmospheric nitrogen concentration due to anthropogenic activities has become a major driver of environmental degradation (Porter et al., 2012; Noyes & Lema, 2015). The interaction between these factors suggests that climate change cannot be separated from other environmental issues. In Indonesia, these changes are narrowing the habitats of endemic species and accelerating the destruction of natural environments already under pressure from human activities.

Deforestation is one of the most serious forms of environmental damage in Indonesia. Large-scale land clearing for agricultural and forestry purposes has resulted in the loss of primary and secondary forests, which serve as vital habitats for a wide range of plant and animal species (Kumar et al., 2024). Consequently, biodiversity has drastically declined, and essential ecosystem services—such as carbon storage, flood regulation, and water cycling—have been significantly disrupted. Yet biodiversity plays a strategic role in maintaining ecosystem stability and productivity, as well as in ensuring the availability of natural resources vital to human life (Kumar et al., 2024).

Amid this complex environmental crisis, the role of education—particularly higher education in science—becomes critically important. Environmental education should not only aim to enhance students' conceptual understanding but also foster positive attitudes and commitments toward conservation. Science students, as future scientists and leaders, carry a moral and intellectual responsibility to address ecological challenges. Therefore, educational approaches must go beyond information delivery to cultivate ecological awareness and strong environmental ethics (Díaz et al., 2019; McElwee et al., 2020). Scientific understanding must be translated into concrete actions that support environmental preservation and ecosystem sustainability.

However, several studies have shown that students' understanding of environmental issues does not always align with pro-environmental behavior in everyday life. Sukri (2023) found that although students recognize the importance of environmental conservation, their actions often do not reflect this awareness. A key factor in this discrepancy is the lack of experiential learning environments that allow direct interaction with nature. Education that is overly theoretical tends to fail in internalizing conservation values, thus preventing the formation of behaviors consistent with acquired knowledge.

Most students understand environmental issues within academic frameworks but lack opportunities to directly experience the complexities of ecological problems in the field. As a result, they struggle to connect scientific concepts with practical actions that could address those problems. Studies indicate that direct experiences—such as involvement in environmental projects or conservation activities—can help students develop deeper

ecological empathy and foster more positive attitudes toward conservation. However, without consistency and support from the education system and a conducive social environment, these positive attitudes are difficult to sustain over time (Cheng et al., 2015).

More broadly, higher education often emphasizes cognitive aspects while neglecting the affective and conative dimensions of environmental learning. Cheng et al. (2015) highlighted that many students find it difficult to act according to their knowledge because environmental issues are not purely scientific but also involve complex social, economic, and political dimensions. This complexity alienates students from environmental decision-making processes and makes them feel powerless to influence policies or enact real change. This imbalance fosters apathy or helplessness, which hinders the development of proactive conservation attitudes.

Fauzi et al. (2022) also noted that students tend to exhibit environmentally concerned behaviors primarily in formal or structured contexts, such as environmental campaigns, volunteer work, or training programs. Such behavior does not necessarily reflect truly internalized attitudes, as students' motivations often stem from academic obligations or social pressure rather than from deeply held personal convictions. This indicates that although environmental literacy among students may be increasing, the transformation of attitudes into consistent conservation behavior remains incomplete.

Social factors also play a vital role in shaping students' attitudes toward environmental conservation. Thompson et al. (2021) found that many students feel they lack effective channels to participate in environmental efforts, despite having strong interest and concern. Frustration over structural barriers and lack of community support leads to feelings of powerlessness, making them reluctant to engage actively in conservation actions. Therefore, it is crucial for educational institutions to create inclusive and empowering participatory spaces, where students can express their views, engage in decision-making, and contribute meaningfully to environmental issues.

Considering these various challenges, it becomes evident that knowledge alone is insufficient to encourage active student involvement in conservation. A more comprehensive approach is needed—one that simultaneously encompasses cognitive, affective, and conative aspects. Analyzing science students' attitudes is essential to understanding the extent of their concern, commitment, and willingness to act in the face of complex environmental issues.

Research Objectives and Novelty

This study aims to analyze science students' attitudes toward environmental conservation issues and actions. By comprehensively exploring the dimensions of student attitudes, the research seeks to provide deeper insights into the factors that influence their engagement in conservation efforts. Furthermore, the study aims to identify the barriers that prevent students from transforming environmental knowledge into concrete action, and to formulate recommendations for enhancing the effectiveness of environmental education in higher education institutions.

The novelty of this study lies in its specific focus on science students, whose academic background is closely linked to environmental issues. Science students were selected under the assumption that they possess a more profound understanding of the ecological and scientific foundations of environmental problems. However, this assumption needs to be tested empirically to determine whether such academic backgrounds genuinely contribute to the development of strong pro-conservation attitudes. The scope of the study includes students from various science programs at universities, employing a descriptive and analytical approach to examine attitude tendencies and their determining factors. The findings of this research are expected to contribute to curriculum development, educational policy, and instructional strategies that can effectively integrate conservation values into higher education practices in a more sustainable and impactful manner.

METHOD

Type of Research

This study employed a mixed-methods approach (Creswell, 2014), combining descriptive quantitative and exploratory qualitative methods. The main focus was on science students' attitudes toward environmental conservation issues and actions. The quantitative approach was used to illustrate students' attitude tendencies based on questionnaire scores, while the qualitative approach explored students' views, personal values, and emotional experiences in greater depth. This research is descriptive in nature and does not aim to test relationships between variables.

The strength of the mixed-methods approach lies in its ability to integrate numerical and narrative data simultaneously, thereby overcoming the limitations of each method when applied independently. Quantitative analysis offers a general overview and aggregate patterns of student attitudes, while qualitative analysis adds interpretive and contextual nuances. Through this methodological triangulation, the study results become more valid, reflective, and comprehensive, capturing the complexity of affective factors that are not easily measured by statistics alone. This approach also enables the identification of subjective yet critical dynamics in conservation education.

Population and Sample

The population of this study consisted of active science students enrolled in a public university in Indonesia. Sampling was conducted using purposive sampling based on the following criteria: (1) students were at least in their fourth semester; (2) had taken or were currently enrolled in a course related to environmental issues; and (3) were willing to participate in the survey and/or interview. A total of 43 students participated in the quantitative phase, with demographic details presented in Table 1.

Table 1. Respondent demographics

Category	Subcategory	Number of Respondents
Study Program	Biology Education	19
	Chemistry Education	14

Category	Subcategory	Number of Respondents
	Physics Education	10
Gender	Male	10
	Female	33
Qualitative Respondents	Selected from total	6

Before data collection, participants were informed about the objectives, procedures, and voluntary nature of their involvement in the study. Informed consent was obtained online for the questionnaire and verbally prior to the interviews. The researchers ensured the confidentiality of respondents' identities and maintained the integrity of the collected data. The study was conducted in adherence to ethical principles in social and educational research and received ethical clearance from the hosting institution.

Instruments and Parameters

The primary instrument for the quantitative phase was a closed online questionnaire consisting of 10 statements using a five-point Likert scale: Strongly Agree (5), Agree (4), Neutral (3), Disagree (2), and Strongly Disagree (1). The questionnaire was specifically designed to measure students' attitudes toward environmental conservation. Instrument validation involved two stages: (1) content validation by three environmental education experts and (2) construct validity testing through item-total correlation using a pilot sample of 30 students. All items yielded correlation coefficients ranging from $r = 0.462$ to 0.781 and were significant at $p < 0.01$, confirming their validity. Reliability testing produced a Cronbach's Alpha of 0.843, indicating high internal consistency.

The ten items in the questionnaire were categorized into four attitude parameters, as shown in Table 2.

Table 2. Attitude parameters based on questionnaire items

No	Attitude Parameter	Statement Numbers	Description
1	Sense of responsibility and personal commitment	(1), (10)	Belief in personal responsibility and the contribution of daily behaviors.
2	Interest and emotional involvement in conservation	(2), (6), (7)	Engagement and interest in conservation activities and environmental communication.
3	Personal values toward conservative practices	(3), (5), (9)	Personal preferences for eco-friendly actions and policy support.
4	Appreciation for environmental knowledge and education	(4), (8)	Recognition of the importance of conservation knowledge and its integration into the curriculum.

The qualitative instrument consisted of an open-ended interview guide used to explore students' perceptions of environmental conservation in depth, including personal

experiences, emotional values, affective motivations, and reflections on environmental education and conservation policy roles.

Data Collection Procedure

Quantitative data were collected by distributing an online questionnaire to 43 respondents. Each respondent rated 10 items, resulting in a minimum total score of 10 and a maximum of 50. The mean score was used to categorize students' attitudes toward conservation issues and actions into five categories, as shown in Table 3.

Table 3. Student Attitude Categories

No	Attitude Category	Mean Score Range
1	Very good	42.1 – 50.0
2	Good	34.1 – 42.0
3	Fair	26.1 – 34.0
4	Poor	18.1 – 26.0
5	Very poor	10.0 – 18.0

Qualitative data were gathered through online interviews with six selected respondents. Each interview lasted between 30 and 45 minutes per session and was recorded with the respondent's consent. All interviews were transcribed verbatim for subsequent analysis.

Data Analysis

Quantitative data were analyzed descriptively using SPSS version 26.0. The analysis included calculations of mean, median, mode, and standard deviation for overall attitude scores and by individual parameters. Respondent data were then categorized according to the classification in Table 3.

Qualitative data were analyzed using thematic analysis, involving stages of transcription, open coding, data categorization, identification of major themes, and narrative interpretation. Findings from the qualitative approach were used to complement and clarify the results of the quantitative analysis, offering deeper insights into affective factors influencing students' attitudes toward environmental conservation. Data validity was strengthened through methodological triangulation that integrated both quantitative and qualitative findings.

RESULTS AND DISCUSSION

A descriptive analysis of the quantitative data was conducted to illustrate the general tendency of science students' attitudes toward environmental conservation issues and actions. Based on the responses of 43 participants, the total individual attitude scores ranged from 8.00 to 39.00. The maximum possible score on the instrument was 50, and the minimum was 10. The main descriptive statistics are presented in Table 4.

Table 4. Descriptive statistics of student attitudes

No	Statistic	Value
1	Number of Respondents	43

No	Statistic	Value
2	Minimum Score	8.00
3	Maximum Score	39.00
4	Mean	24.56
5	Median	24.00
6	Mode	23.00
7	Standard Deviation	6.89

The mean attitude score of 24.56 falls within the "Poor" category based on the predefined classification range (18.1–26.0). A median score of 24.00 and a mode of 23.00 indicate that more than half of the respondents tended to score low, reflecting weak affective engagement or emotional attachment to environmental conservation issues and actions. The relatively large standard deviation (6.89) suggests a considerable variation in attitude scores among respondents.

The distribution of respondents across the different attitude categories is shown in Table 5 and Figure 1.

Table 5. Distribution of student attitude categories

No	Attitude Category	Score Range	Number of Students	Percentage (%)
1	Very good	42.1 – 50.0	0	0,00%
2	Good	34.1 – 42.0	3	6,98%
3	Fair	26.1 – 34.0	11	25,58%
4	Poor	18.1 – 26.0	24	55,81%
5	Very poor	10.0 – 18.0	5	11,63%
Total		—	43	100%

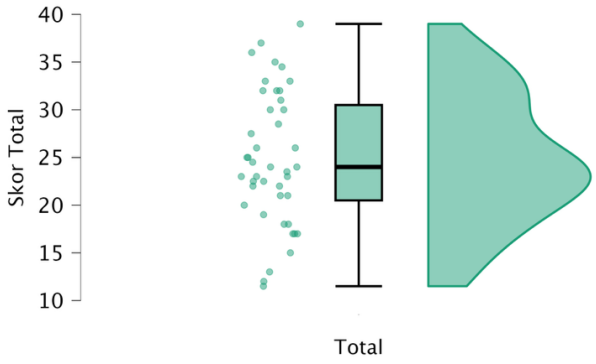

Figure 1. Descriptive plot of student attitudes

A total of 24 out of 43 students (55.81%) fell into the "Poor" category, indicating that the majority of respondents held weak attitudes toward environmental conservation issues. Meanwhile, 11 students (25.58%) were classified as "Fair", and only 3 students (6.98%) were in the "Good" category. No respondents achieved a "Very Good" rating, while 5 students (11.63%) were categorized as having "Very Poor" attitudes.

Further analysis was conducted using a binomial test to determine whether the proportion of students' total attitude scores significantly differed from the theoretical proportion of 0.5 (the midpoint representing a balanced proportion between high and low attitudes). The results of the binomial test are presented in Table 6.

Table 6. Binomial test results for students' total attitude scores

Level	Counts	Total	Proportion	p-value	95% CI for Proportion	
					Lower CI	Upper CI
11.5	1	43	0.023	< .001	5.886×10^{-4}	0.123
12	1	43	0.023	< .001	5.886×10^{-4}	0.123
13	1	43	0.023	< .001	5.886×10^{-4}	0.123
15	1	43	0.023	< .001	5.886×10^{-4}	0.123
17	3	43	0.070	< .001	0.015	0.191
18	2	43	0.047	< .001	0.006	0.158
19	1	43	0.023	< .001	5.886×10^{-4}	0.123
20	1	43	0.023	< .001	5.886×10^{-4}	0.123
21	2	43	0.047	< .001	0.006	0.158
22	2	43	0.047	< .001	0.006	0.158
22.5	2	43	0.047	< .001	0.006	0.158
23	3	43	0.070	< .001	0.015	0.191
23.5	1	43	0.023	< .001	5.886×10^{-4}	0.123
24	2	43	0.047	< .001	0.006	0.158
24.5	1	43	0.023	< .001	5.886×10^{-4}	0.123
25	2	43	0.047	< .001	0.006	0.158
26	2	43	0.047	< .001	0.006	0.158
27.5	1	43	0.023	< .001	5.886×10^{-4}	0.123
28.5	1	43	0.023	< .001	5.886×10^{-4}	0.123
30	2	43	0.047	< .001	0.006	0.158
31	1	43	0.023	< .001	5.886×10^{-4}	0.123
32	3	43	0.070	< .001	0.015	0.191
33	2	43	0.047	< .001	0.006	0.158
34.5	1	43	0.023	< .001	5.886×10^{-4}	0.123
35	1	43	0.023	< .001	5.886×10^{-4}	0.123
36	1	43	0.023	< .001	5.886×10^{-4}	0.123
37	1	43	0.023	< .001	5.886×10^{-4}	0.123
39	1	43	0.023	< .001	5.886×10^{-4}	0.123

Note: Proportions tested against value: 0.5

The results showed that all individual score levels had proportions significantly lower than 0.5, with p-values < .001 for all levels. For instance, the most frequently occurring scores—17, 23, and 32—each appeared in 3 respondents (7%), still indicating a proportion well below 0.5 (proportion = 0.070; p < .001; 95% CI: 0.015–0.191). Other scores, including both low values like 11.5 and 12 and higher scores like 39, appeared in only one respondent (2.3%) and were associated with very narrow confidence intervals (lower CI: ±0.0006).

These findings reinforce the previous descriptive results, indicating that most students had attitude levels below the optimal category. The fact that none of the score levels reached a proportion close to the midpoint (0.5) suggests an overall lack of dominant positive attitudes within the respondent population. Thus, based on both the frequency distribution and the binomial test, it can be concluded that science students' attitudes toward environmental conservation issues and actions remain weak and inconsistent across respondents. These findings point to an urgent need to strengthen the affective dimension in environmental education, so that students' understanding can be accompanied by deeper and more meaningful attitudes.

This situation aligns with prior studies that highlight a persistent gap between knowledge and action on environmental issues. Cheng et al. (2015) emphasized that students often struggle to convert knowledge into action due to limited affective engagement with issues that are socially and emotionally complex. Similarly, Nuangchalerm et al. (2022) noted that although pre-service science teachers understand the importance of conservation, their commitment to practical implementation remains underdeveloped due to social and cultural factors that obscure the application of conservation values.

In addition, Tanti et al. (2021) emphasized the importance of positive perceptions of science learning in shaping students' environmental attitudes. When science is taught in an engaging and emotionally resonant manner, students are more likely to show strong involvement in environmental issues. In contrast, dry and overly theoretical approaches often fail to internalize conservation values. This is further supported by findings from Rahmawati et al. (2020), who showed that knowledge does not always correlate with attitude; instead, perception and social context are key variables that mediate this relationship.

Consequently, this study underscores the need to reformulate environmental education strategies within science faculties. Education that focuses solely on cognitive aspects is insufficient to foster students' emotional engagement with conservation issues. A more holistic and transformative approach is required—one that not only informs but also inspires and activates personal values and student empathy. Through the explicit integration of affective dimensions into curricula and learning practices, students are expected to develop a strong commitment to environmental preservation as part of their moral and academic responsibility.

To complement the quantitative findings, which indicated the dominance of the "Poor" attitude category, a qualitative approach was employed to explore in greater depth the emotional dimensions and personal values of students toward environmental conservation issues and actions. Six science students from various academic programs were selected as interview respondents through purposive sampling, taking into account the diversity of their backgrounds and levels of engagement in environmental activities.

Thematic analysis of the interview transcripts revealed three major themes representing students' attitudinal dimensions: (1) awareness of personal responsibility, (2) emotional attachment to conservation, and (3) psychosocial barriers to pro-environmental behavior.

Each theme emerged through open coding and categorization of data based on patterns of similarity across participants' responses. A summary of these qualitative findings is presented in Table 7.

Table 7. Summary of qualitative findings based on interview results

Respondent	Main Theme	Category Code	Representative Quote
R1	Awareness of personal responsibility	Individual responsibility	*"I feel a moral obligation to protect the environment around me, although sometimes I'm unsure where to start."*
R2	Emotional engagement with conservation	Emotional satisfaction through involvement	*"I feel happy and relieved when joining campus clean-ups—like I'm contributing something real."*
R3	Psychosocial barriers	Sense of helplessness, lack of social support	*"I want to be active, but sometimes I think, what's the point if not many others are involved?"*
R4	Emotional engagement with conservation	Contextual involvement in collective activity	*"If there's a group event, I feel motivated. But alone, I sometimes forget or feel lazy."*
R5	Awareness of personal responsibility	Normative awareness, low behavioral internalization	*"I know the environment is important, but I haven't made it a habit to do small things like disposing of waste properly."*
R6	Psychosocial barriers	Academic pressure and competing priorities	*"Assignments sometimes keep me from engaging in environmental activities, even though I'm interested."*

The qualitative findings revealed three core dimensions of science students' attitudes toward environmental conservation: awareness of personal responsibility, emotional attachment to conservation, and psychosocial obstacles that hinder the internalization of attitudes into consistent behaviors. Generally, students expressed a normative understanding that environmental preservation is an individual responsibility. This was evident in statements emphasizing the importance of personal contributions to sustainability. However, this acknowledgment has yet to fully translate into consistent and concrete behavior. As reflected in the interviews, many students were aware of conservation issues but struggled to initiate real actions or maintain sustainable habits.

This awareness appears to be more declarative than transformational—driven by normative understanding rather than deeply internalized values. This aligns with the findings of Bhattacharya (2019), who noted that many students articulate pro-conservation views verbally but lack the personal experiences or emotional triggers needed to develop stable and enduring attitudes. In this context, the gap between knowledge and action reflects a lack of

affective depth and the absence of reflective processes necessary to authentically reinforce environmental values.

Additionally, the interviews showed that respondents experienced positive emotional attachment to conservation activities, particularly when these were conducted collectively. Students described feelings of pride, satisfaction, or relief when participating in initiatives such as campus clean-ups or environmental campaigns. These emotions play a crucial role in fostering a sense of connection with nature and the community, validating their participation as meaningful. This supports Wang and Zhang's (2021) argument that emotional engagement in social activities contributes to positive perceptions of conservation and enhances collective responsibility. Such social experiences help foster students' ecological empathy, although they do not necessarily lead to enduring personal behavioral change.

Nevertheless, the enthusiasm generated by collective participation does not always evolve into consistent individual behavior. Many respondents admitted that their motivation waned when acting independently or outside organized social contexts. This shows that students' emotional connection to conservation is still highly dependent on external factors, particularly social support and situational context. Wachholz et al. (2014) observed that students' engagement in environmental actions is often situational and socially incentivized, rather than internally motivated. As a result, while participation may produce emotional satisfaction, conservation values have not yet become integrated into students' behavioral identities.

This reliance on social context undermines the sustainability of attitudes. As noted by Fytopoulou et al. (2023), environmental education that emphasizes short-term project-based participation can raise awareness temporarily but is insufficient to foster long-term commitment without ongoing reinforcement. In such cases, environmental learning must do more than provoke short-lived emotional responses—it should provide structured opportunities that promote value internalization and expand practical spaces where students can experience and reflect on conservation in everyday life.

The third key dimension revealed in the qualitative findings is the existence of significant psychosocial barriers. Respondents cited academic demands, the absence of supportive communities, and feelings of powerlessness as the main constraints to taking action. Many students believed their individual actions were too insignificant to address the complexity of the environmental crisis. This sense of helplessness reduces motivation and reinforces apathy toward change. These findings echo those of Cengiz and Bahar (2023), who found that students often refrain from taking conservation action due to a perceived lack of influence over social or policy change.

This sense of helplessness is further exacerbated by heavy academic workloads, which make environmental conservation a low priority in students' daily lives. Müderrisoğlu and Altanlar (2010) noted that without supportive communities that promote pro-environmental behavior, students tend to revert to pragmatic lifestyles, neglecting ecological considerations

in decision-making. These conditions deepen the gap between attitudes and actions and hinder the formation of a conservation culture among science students.

The findings also highlight the importance of strengthening psychosocial empowerment in environmental education. When students are given opportunities to feel empowered, participate in decision-making, and engage in real-world community activities, they are more likely to form deep and enduring attitudes. Fielding and Hornsey (2016) emphasized that a sense of belonging and personal agency is crucial to building emotional engagement with environmental issues, ultimately fostering consistent ecological behavior.

Therefore, environmental education in universities must shift from being merely informative to truly transformative. Education should not only transmit knowledge about conservation but also develop personal values, stimulate emotional reflection, and empower students as agents of change. In this regard, Fritsche et al. (2018) proposed an environmental education model that integrates cognitive, affective, and socio-political dimensions to cultivate collective responsibility while strengthening individuals' capacity to act.

These qualitative findings affirm the urgency of adopting a holistic approach to shaping students' environmental attitudes. Although seeds of awareness and concern have been planted, they have not yet become part of students' behavioral identities. Educational strategies must combine emotional experience, collective participation, and sustained social support to build a strong foundation of environmental attitudes. Only through such strategies can science students move from passive observers to active participants in transformative and sustainable conservation efforts.

The quantitative and qualitative findings of this study are complementary in capturing the current state of science students' attitudes toward environmental conservation issues and actions. The quantitative data showed low average attitude scores, indicating limited emotional engagement with environmental issues. This is supported by qualitative findings showing that although students expressed normative awareness and emotional interest in conservation, their engagement has not yet become internalized as consistent and autonomous behavior. Instead, positive attitudes tend to emerge in collective and social contexts, but remain hindered by academic pressure and limited community support. Together, these findings underline the need to reformulate environmental education strategies in higher education—moving beyond the transmission of knowledge to include space for meaningful emotional experiences, the development of personal values, and psychosocial empowerment—so that emerging attitudes may evolve into genuine commitment and sustainable conservation action.

CONCLUSION

This study reveals that science students' attitudes toward environmental conservation issues and actions remain at a relatively inadequate level. Quantitative findings indicate that most respondents obtained low attitude scores, with the majority falling into the "Poor" and "Very Poor" categories. No respondents reached the "Very Good" category, and only a small proportion were categorized as "Good." These results suggest that the affective dimension—

including personal responsibility, emotional engagement, conservative values, and appreciation of environmental education—has not been strongly internalized by science students, despite their academic proximity to environmental issues.

The qualitative findings complement this picture by revealing the presence of emerging awareness and emotional involvement, especially within social and collective contexts. However, such engagement is situational and has yet to develop into consistent personal habits. Psychosocial barriers—such as academic pressure, feelings of helplessness, and lack of community support—significantly hinder the development of consistent pro-environmental attitudes. These findings underscore that normative awareness alone is insufficient without educational experiences that engage the emotional dimension and empower students socially.

Therefore, there is a need to reformulate environmental education strategies in higher education, particularly within science programs. A transformative approach that integrates cognitive, affective, and social dimensions should be adopted to ensure that students not only understand environmental issues scientifically but also internalize them as part of their values and identity. A curriculum that incorporates strong affective experiences, personal value reflection, and inclusive participatory spaces can serve as a foundation for building genuine and sustainable conservation commitment among science students.

LIMITATIONS

This study has several limitations that should be considered when interpreting its results. The relatively small number of respondents—43 students from a single higher education institution—may limit the generalizability of the findings to the national population of science students. Additionally, the qualitative phase involved only six informants, which may not fully capture the diversity of affective experiences. The use of an online questionnaire also carries the potential for response bias, such as social desirability tendencies. Lastly, the exclusive focus on attitudes without integrating cognitive and conative dimensions restricts a more comprehensive understanding of students' environmental profiles.

RECOMMENDATION

Based on the findings and limitations of this study, it is recommended that higher education institutions develop environmental curricula that explicitly integrate the affective dimension through participatory, reflective, and experiential approaches. Learning programs should provide opportunities for students to engage in meaningful and authentic conservation activities, both individually and collectively, to strengthen the internalization of conservative values. For future research development, studies should be expanded with a larger and more diverse sample, and consider adopting a longitudinal design to evaluate attitude dynamics over time.

Author Contributions

The authors have sufficiently contributed to the study, and have read and agreed to the published version of the manuscript.

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