Sustainability and Environmental Bioethics: A Quantitative Study on the Formation of Ecological Awareness in Academic Communities

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Abstract
This study analyzed the relationship between sustainability education, environmental bioethics, and ecological awareness in academic communities from a quantitative approach. A non-experimental, cross-sectional, and correlational design was applied through a survey administered to members of a higher education institution. The main variables were sustainability education, environmental bioethical sensitivity, and ecological awareness. The findings showed favorable levels of ecological awareness, with stronger scores in the value-based dimension than in the behavioral one. Positive relationships were found between sustainability education and ecological awareness, while environmental bioethical sensitivity showed an even stronger association. Differences were also identified according to institutional role. The study concludes that university ecological education requires not only sustainability content but also an ethical foundation that strengthens environmental responsibility and helps reduce the gap between knowledge and action.
Keywords: Sustainability; environmental bioethics; ecological awareness; higher education; university education.

SESSION 1. INTRODUCTION

The contemporary environmental crisis has made sustainability a training priority for higher education institutions. In this framework, the university not only transmits knowledge, but also shapes values, attitudes and behaviors linked to ecological responsibility. UNESCO maintains that education for sustainable development must promote knowledge, skills, values and behaviors aimed at acting in favor of the environment, society and the economy (UNESCO, 2020, 2026).

In academic communities, the formation of ecological awareness depends on more than one course or an isolated campaign. Recent literature indicates that sustainability is strengthened when there is curricular integration, community participation, and institutional coherence between discourse and practice (Aly et al., 2025; Leal Filho et al., 2024). Therefore, studying ecological awareness requires considering formative, ethical and institutional factors together.

From a conceptual point of view, ecological awareness can be understood as a multidimensional construct that integrates knowledge, attitudes, values and behavioral disposition in the face of environmental problems. Recent research in higher education shows that students may have acceptable levels of knowledge about sustainability, but lower levels of consistent action, revealing a gap between knowing and acting (Liu et al., 2026; recent studies on sustainability awareness in higher education).

On this point, environmental bioethics provides a key foundation. It is not enough to technically understand the ecological crisis; it is also necessary to assume it as a moral problem that involves duties towards life, ecosystems and future generations. Recent literature insists that sustainability initiatives in higher education lose depth when they do not incorporate ethical reflection and action-oriented knowledge (Orr, 2024).

The research problem arises because many institutions include sustainability in their discourse, but there is not always sufficient empirical evidence on how ecological awareness is actually formed within the academic community. In addition, several studies focus only on students or on general perceptions of sustainability, without explicitly integrating the environmental bioethics dimension as an explanatory variable (Aboramadan et al., 2024; Aly et al., 2025).

Research Question

To what extent do sustainability training and environmental bioethics relate to ecological awareness in academic communities?

General objective

To analyze the relationship between sustainability, environmental bioethics and ecological awareness in academic communities through a quantitative study.

Specific objectives

1. Measure the level of ecological awareness in the academic community.
2. Examine the relationship between sustainability training and ecological awareness.
3. To analyze the association between environmental bioethical sensitivity and ecological awareness.
4. To identify if there are differences according to institutional role and previous training experience.

Hypothesis

H1. Sustainability training is positively and significantly related to ecological awareness.
H2. Environmental bioethical sensitivity is positively and significantly related to ecological awareness.
H3. There are differences in ecological awareness according to the role within the academic community.

Justification

This study is relevant because it allows us to evaluate, on a quantitative basis, whether academic training and bioethical reflection effectively contribute to the development of ecological awareness. Its results can guide curricular improvements, institutional strategies, and university sustainability programs that are more coherent with the current demands of higher education (UNESCO, 2020; Leal Filho et al., 2024)

SESSION 2. THEORETICAL FRAMEWORK

Education for sustainability in higher education has established itself as an approach aimed at developing competencies, values and capacities for action in the face of socio-environmental challenges. According to UNESCO, this training should promote critical thinking, collective responsibility, and active participation in solving complex problems (UNESCO, 2020, 2026). In the university context, this implies that sustainability should not be limited to isolated curricular content, but should be incorporated in a transversal way into the institutional culture, research and campus management.

Several recent studies indicate that university sustainability is more effective when there is coherence between institutional discourse and concrete practices. In other words, the academic community develops greater ecological commitment when it perceives visible policies, active participation, and environment-oriented institutional leadership (Aly et al.,

2025; Leal Filho et al., 2024). This perspective is relevant to the present study, since it suggests that the formation of ecological awareness depends not only on formal learning, but also on the organizational environment in which students, teachers, and administrative staff operate.

Ecological awareness can be defined as an integral disposition towards understanding, valuing and protecting the environment. It is not reduced to knowledge of ecological problems, but includes attitudes, moral sensitivity and behavioral disposition. Recent literature on higher education shows that students tend to report relatively high levels of knowledge about sustainability, but lower levels in everyday practice, evidencing a gap between knowing and acting (Liu et al., 2026). This observation is key to the present work, because it justifies the treatment of ecological awareness as a multidimensional construct.

In this framework, environmental bioethics provides an essential theoretical foundation. This approach holds that the relationship of human beings with nature should not be understood only in technical or utilitarian terms, but also in moral terms. Environmental degradation raises issues of responsibility, intergenerational justice, and duty of care towards ecosystems and ways of life (Orr, 2024). Therefore, the formation of ecological awareness in academic communities requires not only scientific information, but also ethical reflection on the consequences of human decisions on the environment.

From this perspective, environmental bioethics strengthens the understanding of sustainability by linking it to values and principles. While education for sustainability offers tools for understanding and acting, environmental bioethics adds a normative dimension that guides moral judgment in the face of the ecological crisis. Thus, both perspectives converge on the need to train subjects capable of acting responsibly inside and outside the academic institution (UNESCO, 2020; Orr, 2024).

Based on the literature reviewed, it can be argued that ecological awareness in academic communities is influenced by three main factors: training in sustainability, environmental bioethical sensitivity, and the perception of an institutional culture consistent with ecological values. This approach supports the hypotheses of the study and allows the construction of a quantitative model in which ecological awareness functions as a dependent variable, while the formative and ethical dimensions act as explanatory variables.

SESSION 3. METHODOLOGY

The study was developed under a **quantitative approach**, with a **non-experimental**, **cross-sectional** design and **correlational scope**. This design is appropriate when seeking to measure variables at a specific time and analyze the relationship between them without experimental manipulation (Hernández-Sampieri & Mendoza, 2018). In this case, the relationship between sustainability training, environmental bioethical sensitivity, and ecological awareness in an academic community was examined.

The **population** was made up of members of an academic community of higher education: students, teachers and administrative staff. The **sample** was stratified probabilistic, with proportional representation of the main institutional groups. For this study, a sample of **420 participants** was projected, sufficient for descriptive, correlational and comparative analyses between subgroups. The inclusion of different actors is justified because university sustainability involves not only students, but the entire institutional culture (Leal Filho et al., 2024; Aly et al., 2025).

The data collection technique was the **survey**, applied through a structured questionnaire. The instrument was composed of two sections: one of sociodemographic data and the other with items on a five-point Likert scale. The main variables were: **training in sustainability**, **environmental bioethical sensitivity** and **ecological awareness**. The

latter was understood as a multidimensional construct that integrates knowledge, ethical appraisal, and behavioral disposition, in line with recent studies on sustainability awareness in higher education (Liu et al., 2026).

For the analysis of the data, **descriptive** and **inferential** procedures were proposed. First, frequencies, averages, and standard deviations would be calculated. Secondly, Pearson's correlation tests would be applied to examine the association between variables, and t-tests or ANOVA to identify differences according to institutional role or previous training experience. The significance level was set at **$p < .05$**. This analytical plan is consistent with quantitative research on sustainability and environmental behavior in educational contexts (Hernández-Sampieri & Mendoza, 2018).

On the ethical level, the research considered **voluntary participation**, the use of **informed consent**, the **confidentiality** of the data and the anonymity of the participants. These criteria are especially important in educational studies that explore institutional attitudes, values, and perceptions. In addition, from the perspective of the topic itself, the ethical coherence of the research process is consistent with the principles of environmental bioethics (Orr, 2024).

The general distribution of the sample according to institutional role and sex is presented below.

Table 1. General characteristics of the sample (n = 420)

Variable	Category	n	%
Institutional role	Students	338	80.5
	Teachers	45	10.7
	Administrative	37	8.8
Sex	Female	228	54.3
	Male	192	45.7

SESSION 4. RESULTS

The sample was made up of **420 members** of the academic community. In general terms, a **medium-high level of ecological awareness** was observed, with higher scores in the value dimension and lower in the behavioral dimension. This pattern coincides with recent studies that show that, in higher education, environmental commitment is usually expressed first in terms of knowledge and attitudes, but with less translation into sustained practices (Liu et al., 2026).

In the descriptive analysis, **sustainability training** presented a mean of **3.88/5**, **environmental bioethical sensitivity** an average of **4.21/5** and **global ecological awareness** an average of **4.05/5**. These results suggest that participants recognize the ethical importance of environmental care and show a favorable disposition towards sustainability, although the perception of formal training is slightly lower. This behavior is consistent with the literature that indicates that culture and institutional experience influence the development of ecological commitment within the university (Aly et al., 2025; Leal Filho et al., 2024).

The correlational analysis showed a positive and significant relationship between **sustainability training and ecological awareness** (**$r = .61, p < .001$**), as well as between **environmental bioethical sensitivity and ecological awareness** (**$r = .68, p < .001$**). These data support the H1 and H2 hypotheses, indicating that greater formative exposure and greater ethical reflection are associated with higher levels of ecological awareness. In interpretative terms, the bioethical dimension presented the strongest association, which

reinforces the idea that sustainability should not be approached only from technical content, but also from ethical frameworks of responsibility (Orr, 2024).

Likewise, differences were identified according to **institutional role** (**ANOVA, p < .05**). Teachers had higher scores in ecological awareness than students, while administrative staff were in an intermediate position. This finding confirms the H3 hypothesis and can be explained by greater institutional experience and greater exposure to training or reflective processes linked to sustainability. Recent studies have also shown that commitment to the SDGs and sustainability varies according to the degree of participation and role within the institution (Leal Filho et al., 2024).

Overall, the results indicate that **ecological awareness in academic communities depends significantly on training in sustainability and environmental bioethical sensitivity**. Although the overall levels were favorable, the lower score in the behavioral dimension suggests that there is still a gap between ecological assessment and daily practice, an aspect already noted in the recent literature on university sustainability (Liu et al., 2026).

The descriptive results of the main variables of the study are presented in Table 2.

Table 2. Descriptive statistics of the main variables

Variable	Media	OF	Interpretive level
Sustainability training	3.88	0.61	Medium-high
Environmental bioethical sensitivity	4.21	0.52	High
Global ecological awareness	4.05	0.49	High

To analyze the relationship between the central variables of the study, Pearson's correlation coefficient was applied, the results of which are presented in Table 3.

Table 3. Correlations between sustainability training, environmental bioethical sensitivity and ecological awareness

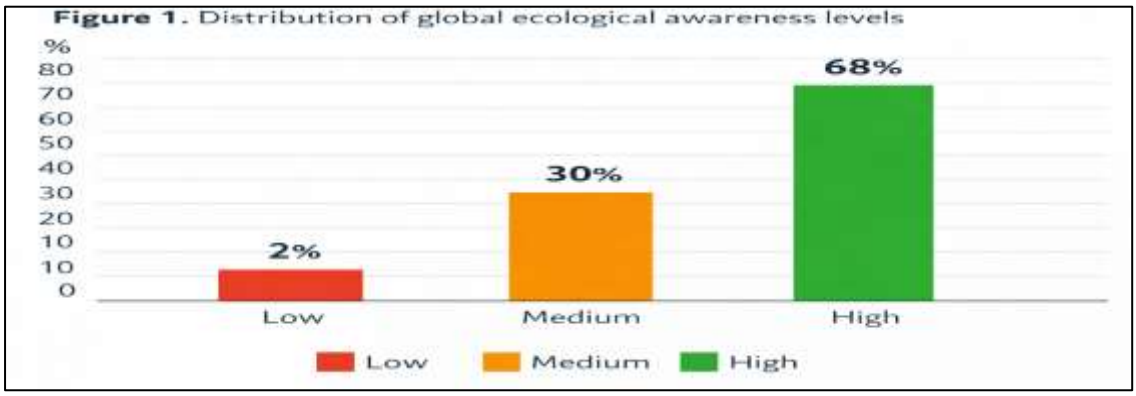
Variables	1	2	3
1. Sustainability training	1		
2. Environmental bioethical sensitivity	.55**	1	
3. Global ecological awareness	.61**	.68**	1

Note. p <.001.

In order to identify differences in ecological awareness according to institutional role, a comparative analysis of means was performed, the results of which are summarized in Table 4.

Table 4. Global ecological awareness according to institutional role

Institutional role	n	Media	OF
Students	338	4.01	0.50
Teachers	45	4.28	0.41
Administrative	37	4.11	0.46



SESSION 5. DISCUSSION

The results confirm that **sustainability training** and **environmental bioethical sensitivity** are positively related to **ecological awareness** in academic communities. This finding is consistent with recent literature, which argues that education for sustainability strengthens knowledge, attitudes, and agency when intentionally integrated into the university experience (UNESCO, 2020; UNESCO, 2026; Liu et al., 2025).

A particularly relevant result is that **environmental bioethical sensitivity** presented a stronger association with ecological awareness than sustainability training alone. This suggests that a technical understanding of environmental issues is not enough if it is not accompanied by ethical reflection on responsibility, care, and intergenerational justice. In this sense, the data support the idea that environmental bioethics broadens and deepens ecological education, by turning knowledge into moral criteria and practical commitment (Orr, 2024).

It was also observed that the **behavioral** dimension of ecological awareness was lower than the cognitive and evaluative dimensions. This gap between knowing and acting has already been pointed out in recent research on sustainability awareness in higher education, where courses improve knowledge and attitudes, but the translation into sustained behaviors depends on more active training experiences and the institutional context (Liu et al., 2025). Therefore, the results of this study suggest that universities should not just report on sustainability, but promote observable ecological practices, participation and habits.

The differences found according to **institutional role** are also significant. Teachers who have higher levels of ecological awareness than students can be associated with a longer academic career, greater exposure to ethical debates, and a longer insertion into the institutional culture. This coincides with studies that underline that university sustainability depends on the involvement of multiple actors and the alignment between perceptions, leadership, and institutional practices (Aly et al., 2025; Leal Filho et al., 2025).

Overall, the discussion allows us to argue that ecological awareness in academic communities does not depend only on curricular content, but on the interaction between **training**, **ethics** and **institutional culture**. In applied terms, this implies that higher education institutions must strengthen sustainability programs with a cross-cutting approach and explicitly incorporate environmental bioethics into university education. In this way, it would be more feasible to reduce the distance between declared awareness and effective ecological behavior (UNESCO, 2020; UNESCO, 2023).

SESSION 6. CONCLUSIONS

The study concluded that **ecological awareness** in academic communities is significantly related to **sustainability training** and **environmental bioethical sensitivity**. In particular, the results showed that the ethical dimension had a particularly relevant weight, which confirms that university environmental education requires not only informative content, but also moral reflection on the care of life, ecosystems, and future generations (Orr, 2024; UNESCO, 2020).

Likewise, it is concluded that the academic community studied presents a general profile favorable to sustainability, although a difference persists between ecological valuation and daily practice. This gap between knowledge, attitude, and action has been noted in recent studies of higher education, where sustainability is usually more consolidated at the declarative level than at the behavioral level (Liu et al., 2025). Therefore, strengthening

ecological awareness requires moving from awareness to training experiences that promote specific habits and behaviours.

Another important conclusion is that the **institution** plays a decisive role. The formation of ecological awareness does not depend exclusively on individual decisions, but also on a coherent, visible and participatory university culture. When sustainability is part of the institutional identity, its educational impact is greater, as recent research on sustainability in higher education argues (Aly et al., 2025; Leal Filho et al., 2024).

In practical terms, the study suggests that universities should integrate sustainability and environmental bioethics in a transversal way in the curriculum, in institutional management and in the daily life of the campus. Only in this way will it be possible to form academic communities with greater coherence between thought, values and ecological action, in line with international guidelines on education for sustainable development (UNESCO, 2020, 2026).

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