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Environmental Science Education Practices and Their Role in Developing Sustainability Awareness Among Higher Education Students

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Abstract

Environmental sustainability is increasingly becoming an area of concern within higher education, pointing out the importance of enhancing the awareness and knowledge of environmental problems. This research paper focuses on the significance of environmental science education practice in creating sustainability awareness in higher education students. For this purpose, a quantitative and cross-sectional research design approach has been used with a structured questionnaire that contains 26 questions in six constructs, including Environmental Curriculum Integration, Experiential Environmental Learning, Environmental Awareness

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Activities, Digital Environmental Learning, Faculty Environmental Engagement, and Sustainability Awareness. The data set of this study includes 500 students' answers from various institutions, and the hypothesized relationships are tested with reliability, correlation, and structural analysis. The measurement results have revealed high internal consistencies with Cronbach's alpha between 0.904 and 0.947. According to the structural analysis, the highest positive impact was observed in terms of Environmental Curriculum Integration towards Sustainability Awareness ($\beta = 0.259$, $p < 0.001$), followed by Experiential Environmental Learning ($\beta = 0.224$, $p < 0.001$), Faculty Environmental Engagement ($\beta = 0.179$, $p < 0.001$), Digital Environmental Learning ($\beta = 0.153$, $p < 0.001$) and Environmental Awareness Activities ($\beta = 0.110$, $p = 0.006$). The model accounted for 44.3% of the variance in Sustainability Awareness ($R^2 = 0.443$). It can be concluded from the results that within the tested structural model, curriculum integration and experiential learning serve as primary drivers for enhancing student sustainability awareness

Keywords:

Environmental education, sustainability awareness, higher education, experiential learning, digital learning, environmental sustainability.

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Introduction

Environmental problems, including global warming, depletion of resources, loss of biodiversity, pollution, and unsustainable consumption, have enhanced the necessity for people to acquire knowledge, attitudes, and behaviors that promote sustainable development. Higher education institutions play an important role in this respect since they train future specialists, decision makers, educators, and leaders who may affect the environment in one way or another. That is why nowadays environmental science education is not only considered as a tool for transmission of ecological knowledge but also a tool for promoting sustainability awareness and proper environmental behavior of students (Yarime et al., 2012; Žalėnienė & Pereira, 2021).
Environmental education is an important means through which sustainability consciousness can be achieved by bridging scientific information with students' attitudes, choices, and actions related to the environment. In this regard, there have been associations found between environmental information and attitudes and environmentally responsible consumption and practices by students, showing that environmental education experience can go beyond the classroom to behavioural domains (Zsóka et al., 2013). In another study, the connection between environmental education and students' perception of sustainability has been shown, emphasizing the value of educational experience in creating the understanding of environmental responsibility and sustainable development among young individuals (Boca & Saraçlı, 2019). Recent findings have also highlighted the connection between environmental education consciousness, SDGs, and environmental responsibility among university students (Aldawsari et al., 2025).

It is not only the formal environmental courses offered at institutions that are important for sustainability. The universities have the potential to foster sustainability in the form of active learning processes through practice-based work, campus-based initiatives, students' involvement, online communication, and institutional participation. Increasingly, students' involvement in sustainability-related activities has been acknowledged as a key mechanism through which the university affects environmental awareness (Sevim & Pala, 2026). At the same time, the effectiveness of sustainability education largely depends on the way in which environmental problems are systematically incorporated into the university programmes. Issues related to sustainability in higher education may include (Dagiliūtė & Liobikienė, 2015; Obrecht et al., 2022).

Digital learning and communications tools can further offer new possibilities for enhancing environmental awareness. For instance, social media can aid in communicating about environmental sustainability and engaging students in higher education institutions (Hamid et al., 2017). The wider use of digital learning and access to information approaches can aid flexible sharing of knowledge related to sustainability, but only if they are appropriately used as part of learning processes. Information management and sharing systems in higher education can further assist in organizing and sharing knowledge, which means that institutions have possibilities for developing learning-based sustainability efforts (Bouzid & Vliet, 2024).

However, one significant question that has not been answered yet despite the increased focus on sustainability in higher education is which educational practices within environmental science can be considered to be the most effective when raising students' sustainability awareness. In general, there have been several research works dedicated to the examination of the students' environmental knowledge, attitude, behavior, institutional sustainability, exercises, and awareness individually (Moody-Marshall, 2023; Haque et al., 2023; Obrecht et al., 2022). Nonetheless, there still exists a possibility to explore the environmental education practices as a multi-dimensional concept and its joint impact on the formation of the students' sustainability awareness. Understanding this relationship is particularly important because awareness represents a critical foundation for students' subsequent environmental attitudes, responsible decision-making, and sustainable practices (Benzehaf et al., 2025; Urbańska et al., 2021).

Consequently, this research is interested in analyzing the influence of practices in environmental sciences education on the development of sustainability awareness among higher education students. The focus of the analysis will be put on those mechanisms that can be used in an educational institution to improve the knowledge of students about sustainability and their responsibilities towards the environment. By conducting empirical research in this area, the study hopes to make a contribution to the literature on sustainability-oriented higher education (Sudheer Reddy & Narendra Kumar, 2025). The operational scope of this study is strictly confined to measuring student-perceived educational practices and self-reported sustainability awareness, excluding direct measurements of institutional environmental outputs.

Research Questions

RQ1: How does environmental curriculum integration influence sustainability awareness among higher education students?
RQ2: What is the effect of experiential environmental learning on sustainability awareness among higher education students?
RQ3: How do environmental awareness activities and digital environmental learning contribute to students' sustainability awareness?
RQ4: What is the influence of faculty environmental engagement on sustainability awareness among higher education students?

Research Objectives

RO1: To examine the influence of environmental curriculum integration on sustainability awareness among higher education students.
RO2: To assess the effect of experiential environmental learning on sustainability awareness among higher education students.
RO3: To investigate the contribution of environmental awareness activities and digital environmental learning to students' sustainability awareness.
RO4: To determine the influence of faculty environmental engagement on sustainability awareness among higher education students.

The paper is divided into seven parts. Section 1 describes the introduction and background of the study. Section 2 discusses the existing literature related to the environment sciences and sustainability awareness. Section 3 builds the theoretical framework and research hypotheses. Section 4 describes the methodology of the research, which includes research design, data collection process, measurement tools, and analysis. Section 5 describes the results and their statistical analysis. Section 6 analyzes the results within the context of the existing literature and provides the limitations of the research and directions for future research. Lastly, Section 7 summarizes the paper and its academic and practical implications.

Literature Review

Environmental Science Education and Sustainability Awareness

Environmental science education equips students with scientific knowledge as well as conceptual knowledge about environmental systems, human-environment interaction, and issues in sustainability. The role of environmental science education in sustainability goes beyond knowledge acquisition because environmental education can impact attitudes and behavior related to the environment. Studies conducted on students have shown the connections among environmental knowledge, environmental attitudes, consumer behavior, and pro-environmental behavior, thus indicating the possibility that environmental education can lead to

sustainability-oriented behavior (Zsóka et al., 2013). Environmental education can also impact the perception of sustainability among students, as environmental awareness has been associated with the role of environmental education (Boca & Saraçlı, 2019).

Environmental education in relation to the SDGs and environmental responsibility has recently been explored for university students, with evidence that sustainability-oriented education can improve students' understanding of their environmental responsibilities (Aldawsari et al., 2025). Furthermore, science education can be an important means by which to help students understand interactions between human activities and environmental systems (Al-Barakat et al., 2025).

Environmental Curriculum Integration

Inclusion of sustainability issues and environmentalism in higher education is an important method of institutionalization of learning about environment. Sustainability in higher education implies integration of sustainability across the processes of academic development, institutionalization, and stakeholder collaborations instead of considering sustainability as a separate issue (Yarime et al., 2012). The global approach to sustainability in higher education stresses the role of universities in including sustainability into the process of learning, studying, researching, and institutional activities (Žalėnienė & Pereira, 2021).

The level of integration of sustainability into the educational programmes may affect how well students will be exposed to the concepts of the environment and be able to relate their knowledge to sustainability issues. Assessment of sustainability in higher education stresses the importance of systematic inclusion of environmental sustainability in education of future professionals and leaders (Obrecht et al., 2022). Consequently, curriculum integration offers a consistent basis for sustainability education instead of engaging into occasional environmental practices.

Experiential and Practical Environmental Learning

Environmental learning becomes more effective when there are opportunities given to students to link theoretical knowledge with practical environmental instances. Practical exercises, sustainability projects, field work, and environmental initiatives would enable students to relate theoretical knowledge with tangible environmental problems and possible solutions to them. In regard to the impact of environmental sustainability exercises in university studies, it is evident that perception and involvement in institutional sustainability practices have been identified as key factors (Haque et al., 2023; Kavitha, 2026).

University contributions in environmental sustainability are also based on the opportunity to engage in sustainability practices and activities, among others (Dagiliūtė & Liobikienė, 2015). Recent findings have shown that engagement and participation are key aspects of the influence of universities in environmental sustainability (Sevim & Pala, 2026). This suggests that experiential learning could foster environmental sustainability by encouraging active involvement in environmental issues.

Environmental Awareness Activities and Student Engagement

Environmental education in relation to the SDGs and environmental responsibility has recently been explored for university students, with evidence that sustainability-oriented education can improve students' understanding of their environmental responsibilities (Aldawsari et al., 2025). Furthermore, science education can be an important means by which to help students understand interactions between human activities and environmental systems (Al-Barakat et al., 2025; Tamrakar & Tandi, 2026).

Sustainability initiatives in institutions can help form perceptions about social responsibility. The social responsibilities of universities in relation to sustainability are pertinent to understanding how sustainability is perceived within higher education institutions (Jung et al., 2019). In institutions, perceptions and awareness by the faculty matter since academics can affect the integration of sustainability in teaching and institutional practices (Christie et al., 2015; Alkhayyal et al., 2019). Therefore, environmental awareness activities need to be conducted within a supportive institutional culture of sustainability.

Digital Environmental Learning and Communication

Moreover, digital platforms present higher education organizations with further channels to communicate environmental information to students and engage them. The value of social media as an important tool to increase awareness of environmental sustainability in higher education through communication and information exchange between students and institutions was revealed (Hamid et al., 2017). Digital learning

can thus complement traditional environmental education by ensuring provision of sustainability information constantly and conveniently (Geetha, 2026).

Nevertheless, the success of the digital approach is contingent on the engagement of students in digital learning and the relevancy of the information being provided. Practices of accessing digital information in higher education indicate the role of the factors determining students' use of distance and digital learning technologies (Sumithra & Sakshi, 2024). Therefore, digital environmental education should be linked to pedagogical purposes and not only increase information access online.

Faculty and Institutional Engagement

Faculty are important players in the translation of sustainable concepts to educational practice. Academic views about environmental sustainability may impact the inclusion of environmental problems in teaching and learning processes (Christie et al., 2015). There is also evidence that the sustainability awareness of faculty members is an institutional aspect of sustainability education (Alkhayyal et al., 2019). The role of universities in promoting environmental learning can be even greater when sustainability practices in educational institutions, interdisciplinarity, involvement of stakeholders, and proper educational resources are involved (Yarime et al., 2012; Žalėnienė & Pereira, 2021). Consequently, the sustainability awareness of students is not limited to individual courses but may develop due to the environment created by the university.

Research Gap

The existing literature establishes the importance of environmental education, sustainability integration, practical learning, student participation, digital communication, and institutional engagement in higher education. However, much of the existing research examines individual aspects of environmental education or focuses on environmental attitudes, practices, institutional sustainability, or perceptions independently. There remains a need for an integrated empirical examination of environmental science education practices and their role in developing sustainability awareness among higher education students. Addressing this gap can provide clearer evidence regarding how educational practices contribute to sustainability-oriented student development and can assist higher education institutions in designing more effective environmental education strategies. While previous literature examines individual educational practices, existing models fail to account for how emerging digital platforms and faculty engagement interact alongside traditional curricula. Furthermore, current frameworks often evaluate institutional sustainability actions without isolating student-level perceptual awareness as a distinct initial outcome.

Theoretical Framework and Hypothesis Development

Although the Theory of Planned Behavior typically incorporates attitudes, subjective norms, and perceived behavioral control, this study intentionally isolates the primary educational antecedents (ECI, EEL, EAA, DEL, FEE). Broader behavioral constructs such as personal environmental values and actual pro-environmental behaviors are excluded from the current framework to focus specifically on the direct educational mechanisms shaping baseline sustainability awareness. It has been found that the knowledge and attitude about the environment influence pro-environmental activities, while sustainability education and institutional involvement help to enhance environmental responsibility among students (Zsóka et al., 2013; Aldawsari et al., 2025; Boca & Saraçlı, 2019). Therefore, the current study views environmental science education practices as essential educational strategies for fostering sustainability awareness of students.

The model includes the following dimensions of environmental science education practices: Environmental Curriculum Integration (ECI), Experiential Environmental Learning (EEL), Environmental Awareness Activities (EAA), Digital Environmental Learning (DEL), and Faculty Environmental Engagement (FEE). Sustainability Awareness (SA) is considered the dependent variable. Curriculum integration ensures the constant presentation of sustainability ideas, while experiential learning helps to relate environmental knowledge to practice. Awareness activities foster participation, digital learning extends access to environmental information, while faculty engagement enhances sustainability ideas in teaching and institutional context (Sevim & Pala, 2026; Christie et al., 2015; Obrecht et al., 2022).

Environmental Curriculum Integration and Sustainability Awareness

The integration of environmental and sustainability issues in university curriculum could enable students to learn about environmental issues and sustainability systematically. Universities are being asked to integrate

sustainability into their teaching and academic development processes as opposed to being taught as standalone issues (Yarime et al., 2012; Žalėnienė & Pereira, 2021). This means that increased integration of environmental issues will increase students' awareness of sustainability issues.

H1: Environmental curriculum integration has a significant positive effect on sustainability awareness among higher education students.

Experiential Environmental Learning and Sustainability Awareness

Experiential learning allows students to use environmental concepts in practical work such as exercises, projects, fieldwork, and sustainability programs. Experiential learning can also help create a relationship between the theory and the reality of environmental issues (Haque et al., 2023). The involvement of students in sustainability programs can also enhance their environmental awareness (Sevim & Pala, 2026; Benzehaf et al., 2025).

H2: Experiential environmental learning has a significant positive effect on sustainability awareness among higher education students.

Environmental Awareness Activities and Sustainability Awareness

Environmental campaigns, sustainability programs, awareness programs, recycling programs, and suchlike can expose students to environmental issues and make them more engaged. Engagement with sustainability programs in universities is connected to the cultivation of environmental awareness and sustainability (Dagiliūtė & Liobikienė, 2015; Benzehaf et al., 2025).

H3: Environmental awareness activities have a significant positive effect on sustainability awareness among higher education students.

Digital Environmental Learning and Sustainability Awareness

Digital platforms function not merely as passive communication channels, but as direct pedagogical drivers that increase exposure, access, and real-time interaction with sustainability concepts, thereby directly enhancing student awareness. Social media and digital platforms are used to promote environmental sustainability through provision of increased information and communication between students and educational institutions (Hamid et al., 2017). Consequently, an effective use of digital learning tools is likely to improve sustainability awareness.

H4: Digital environmental learning has a significant positive effect on sustainability awareness among higher education students.

Faculty Environmental Engagement and Sustainability Awareness

Teachers can influence students through their delivery of the curricula, class discussion, sustainability projects, and mentoring. Faculty perception and institutional involvement are essential in making environmental sustainability part of the practices of higher education institutions (Christie et al., 2015; Alkhayyal et al., 2019). Higher faculty involvement should result in better environmental learning experiences and sustainable awareness among students.

H5: Faculty environmental engagement has a significant positive effect on sustainability awareness among higher education students.

Conceptual Relationship

As per the theoretical basis and empirical findings made by researchers previously, it can be said that environmental science education practices have a role to play in the development of sustainability awareness. Thus, this framework makes direct connections between the five dimensions of environmental science education practices and sustainability awareness (Jayakumari et al., 2026;Ubaydullaeva, 2026).

Research Methodology

Research Design

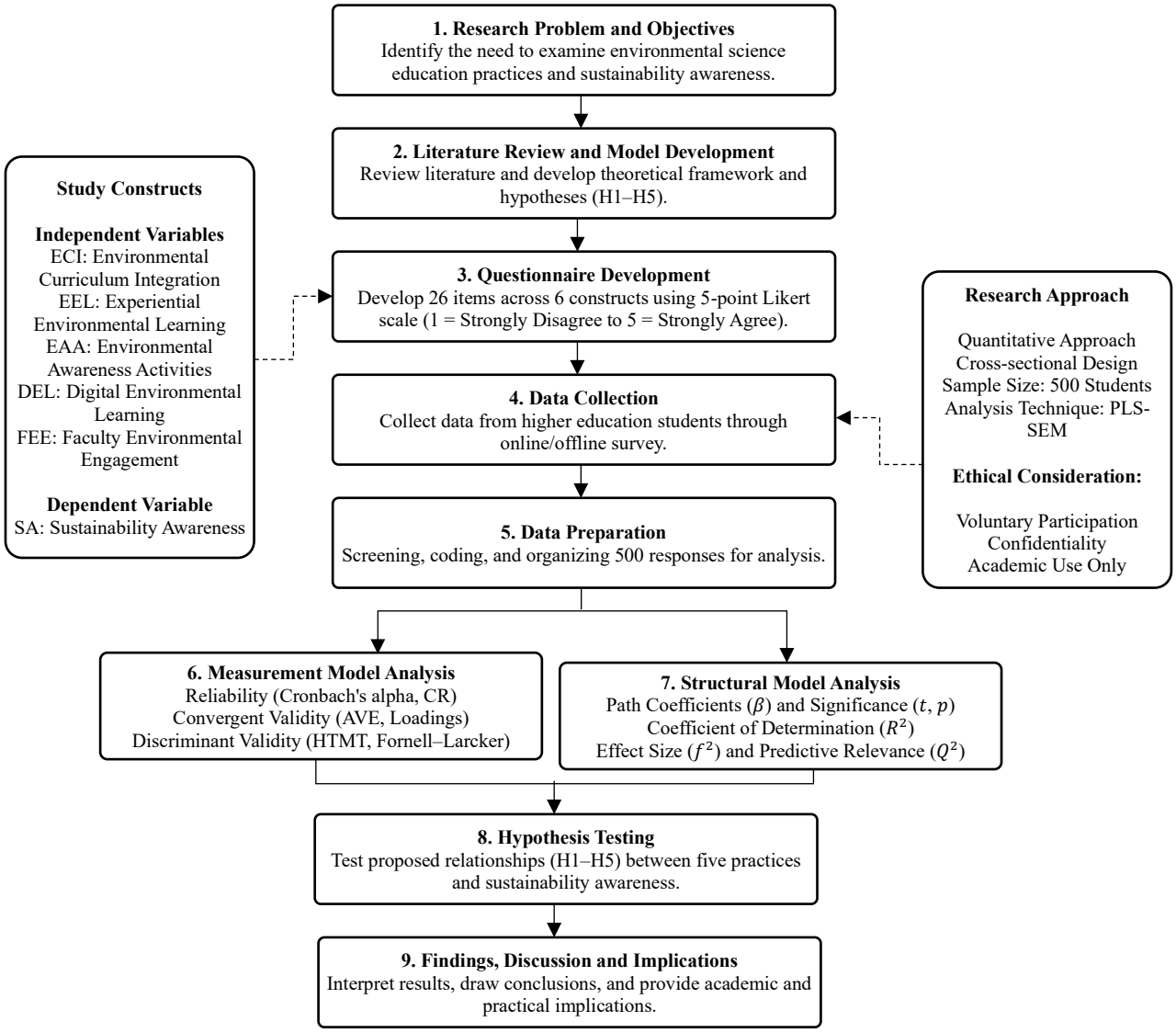

Figure 1. Research methodology framework

In this study, the quantitative, cross-sectional approach will be applied in order to understand the impact of environmental science education practices on sustainability awareness among higher education students. In this regard, the model used in this study involves examining five constructs of environmental science education practices: Environmental Curriculum Integration (ECI), Experiential Environmental Learning (EEL), Environmental Awareness Activities (EAA), Digital Environmental Learning (DEL), and Faculty Environmental Engagement (FEE). Sustainability Awareness (SA) will be taken as the dependent variable. Figure 1 highlights the entire research process starting from the development of questionnaires and data collection to data preparation, measurement model analysis, structural model analysis, and hypothesis testing.

Figure 1 illustrates the sequential research methodology adopted to examine the relationship between environmental science education practices and sustainability awareness.

Study Field and Data Collection

The target group comprises students undertaking university-level programs at both undergraduate and postgraduate levels. The idea behind collecting data from students is to consider variation among different individuals with regard to environmental education and sustainability education. The groups include those studying in various fields such as science and technology, business and management, social sciences and humanities, health sciences, and education. A structured questionnaire will be used for data collection. The questionnaire will be administered either by the direct distribution method or the online survey tool. The questionnaire is voluntary, and respondents are told that their answers are meant for academic purposes. The questionnaire makes use of five-point Likert scale, where 1 is "strongly disagree" and 5 is "strongly agree."

Questionnaire Development

There are 26 items for measurement that are related to six constructs in the questionnaire. ECI, EEL, EAA, DEL, and FEE are measured with 4 items each, while SA is measured with 6 items. The items used for measurement have been designed on the basis of the research framework and previous literature on environmental education, sustainability awareness, student engagement, digital environmental learning, and sustainability integration in higher education (Haque et al., 2023; Obrecht et al., 2022; Benzehaf et al., 2025).

Sampling and Sample Size

The population that will be studied includes students enrolled in higher education programs. The convenience sampling method will be used due to the availability of students through various programs and educational institutions. Attempts will be made to involve students from different fields and levels of study to enhance the diversity of the sample. The data set created for this research project includes 500 observations. These observations are organized on the basis of the created questionnaire and cover responses for all six constructs of the research. The data set will be useful in demonstrating the statistical analysis. To mitigate the inherent selection bias of convenience sampling, proportional quota targets were established across five academic disciplines (Science & Technology, Business, Social Sciences, Health Sciences, Education) and study levels (Undergraduate vs. Postgraduate).

Data Analysis

Partial Least Squares Structural Equation Modelling (PLS-SEM) will be employed to analyse the proposed relationships. First, descriptive statistics will be used to analyse the demographic information as well as the responses of the respondents. In order to test the measurement model, factor loading, Cronbach's Alpha, composite reliability, convergent validity, and discriminant validity are used. Having established that the measurement model is adequate, the structural model will be tested based on path coefficients, coefficient of determination (R^2), effect size (f^2), predictive relevance (Q^2) and bootstrapping. Significance of the structural relationships will be used to test hypotheses H1-H5. The analysis will determine whether ECI, EEL, EAA, DEL, and FEE significantly influence the sustainability awareness of students.

Common Method Bias and Construct Validity

Given the cross-sectional, self-reported nature of the data, Harman's single-factor test was performed; the first factor accounted for less than 50% of the total variance, confirming that Common Method Bias was not a major threat. Additionally, convergent validity was established with all Average Variance Extracted (AVE) values exceeding 0.50, Composite Reliability (CR) exceeding 0.80, and HTMT ratios remaining below the 0.85 threshold to confirm discriminant validity.

Ethical Considerations

Participation in the survey is entirely optional, and the purpose of the study must be explained to the respondents prior to the completion of the questionnaire. No personal details are needed. The gathered data should remain confidential and be used for scholarly purposes only.

Results and Analysis

Respondent Profile

The total number of responses collected in the data set is 500 from higher education students. There exists variability among the sample population in terms of age groups, level of education attained, and discipline of study due to variation in students' experiences in education and sustainability. Most of the respondents are at the undergraduate level, whereas postgraduate students form the rest of the sample population. Students from

science and engineering, business and management, social sciences and humanities, health sciences, education, and other disciplines are represented.

Descriptive Statistics

According to the findings from the descriptive analysis, there seems to be fairly moderate amounts of exposure to environmental education and sustainability awareness. As depicted in table 1 below, all constructs have a mean that is more than the midpoint of the five-point scale. Sustainability Awareness has a mean score of 3.125, while Experiential Environmental Learning has a mean score of 3.122, hence slightly better scores. The least mean score is obtained for Faculty Environmental Engagement at 2.976.

Table 1. Descriptive statistics of the study constructs

Construct	Items	Mean	Standard Deviation
Environmental Curriculum Integration (ECI)	4	3.010	0.93
Experiential Environmental Learning (EEL)	4	3.122	0.92
Environmental Awareness Activities (EAA)	4	3.084	0.91
Digital Environmental Learning (DEL)	4	3.050	0.92
Faculty Environmental Engagement (FEE)	4	2.976	0.92
Sustainability Awareness (SA)	6	3.125	0.86

The pattern of responses at the level of constructs is shown in figure 2. The similarity of the average responses for the environmental education constructs suggests that sustainability awareness can be developed through different educational processes.

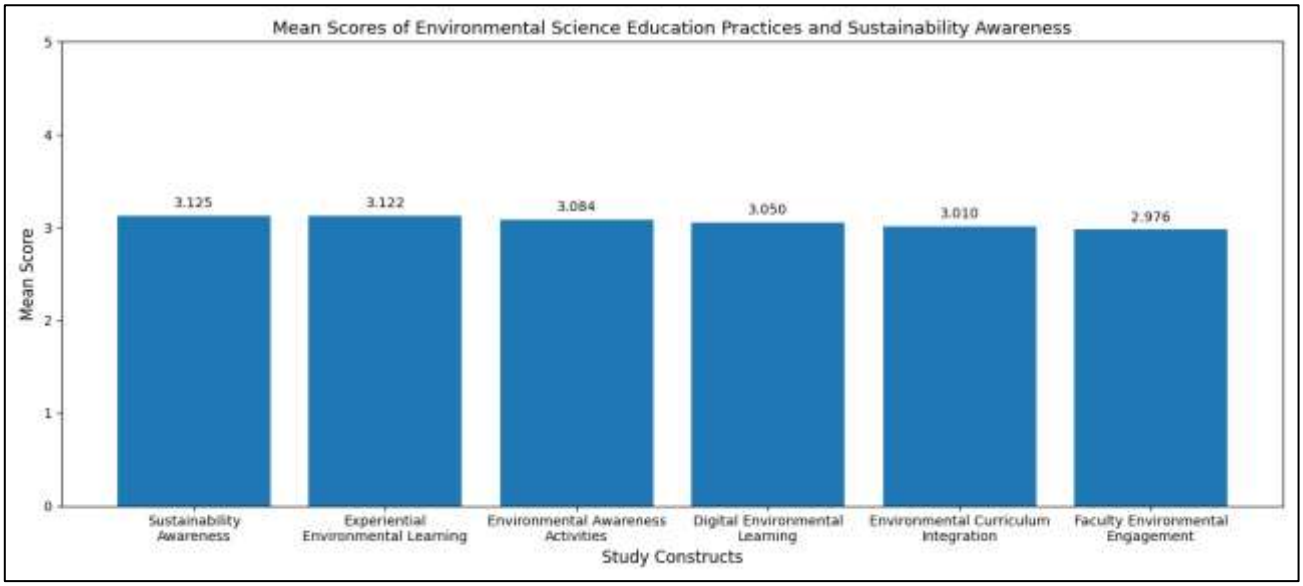

Figure 2. Mean scores of environmental science education practices and sustainability awareness

Reliability Analysis

Cronbach's alpha was used to assess the internal consistency of the measurement constructs. These are listed in table 2 below. It is evident that all constructs have an alpha value greater than 0.90, thus internal consistency among the measurement constructs.

Table 2. Reliability analysis

Construct	No. of Items	Cronbach's Alpha	Reliability
ECI	4	0.904	High
EEL	4	0.909	High
EAA	4	0.916	High
DEL	4	0.917	High
FEE	4	0.909	High
SA	6	0.947	High

As seen in figure 3, all the six constructs are above the reliability threshold of 0.70. Sustainability Awareness is the construct with the highest internal consistency, followed by Digital Environmental Learning and Environmental Awareness Activities.

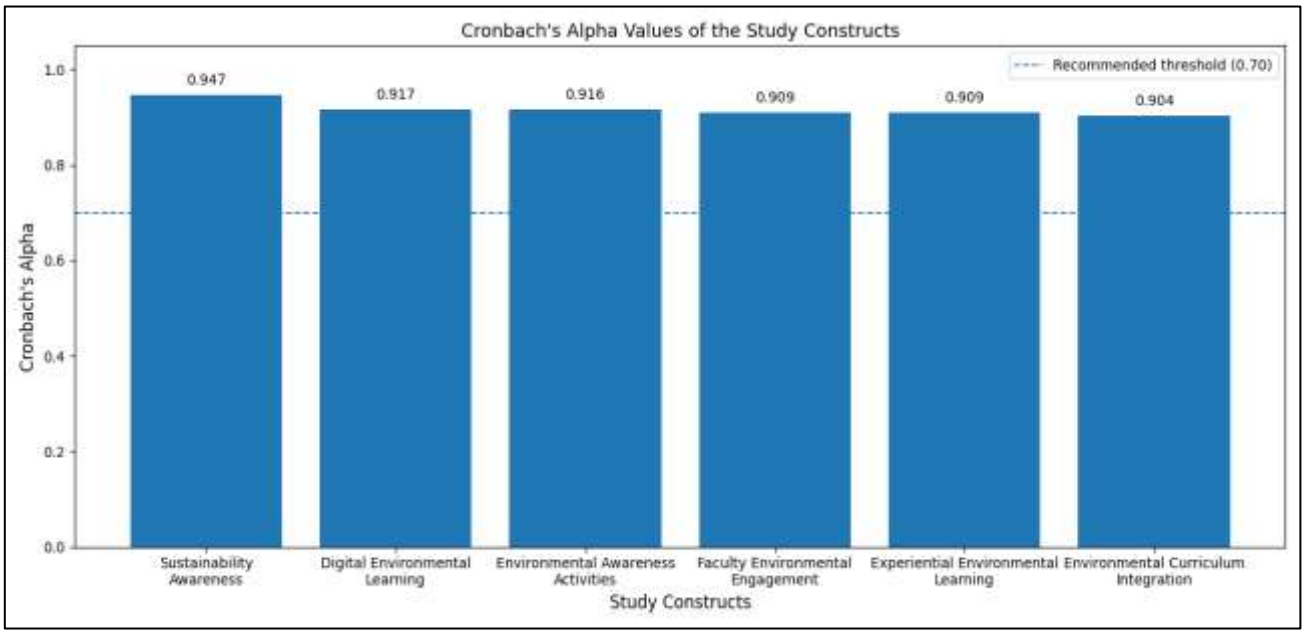

Figure 3. Cronbach's alpha values of the study constructs

Correlation Analysis

The correlation test was used to determine the direction and strength of association between the variables used in this study. table 3 shows the findings of the test.

Table 3. Correlation matrix

Construct	ECI	EEL	EAA	DEL	FEE	SA
ECI	1.000	0.383	0.331	0.287	0.389	0.494
EEL	0.383	1.000	0.399	0.379	0.398	0.503
EAA	0.331	0.399	1.000	0.425	0.459	0.436
DEL	0.287	0.379	0.425	1.000	0.392	0.434
FEE	0.389	0.398	0.459	0.392	1.000	0.481
SA	0.494	0.503	0.436	0.434	0.481	1.000

All of the five environmental education activities exhibit significant relationships with sustainability awareness. Among all, the Experiential Environmental Learning shows the highest correlation with Sustainability Awareness (r = 0.503), whereas the Environmental Curriculum Integration (r = 0.494) and Faculty Environmental Engagement (r = 0.481) are the next best. These findings provide preliminary support for the proposed hypotheses.

Structural Model and Hypothesis Testing

Multiple regression/structural modeling was conducted to assess the independent role of each of the five environmental science education strategies on Sustainability Awareness. The findings are presented in table 4. An additional Multi-Group Analysis (MGA) was performed to evaluate differences across demographic sub-groups. The relationship between ECI and SA was significantly stronger among undergraduate students ($\beta = 0.281$) compared to postgraduates ($\beta = 0.204, p < 0.05$), whereas Faculty Engagement (FEE) showed higher variance explanation among non-science majors. The results support the hypotheses H1 to H5.

Table 4. Structural relationships and hypothesis testing

Hypothesis	Relationship	β	t-value	p-value	Decision
H1	ECI → SA	0.259	6.656	<0.001	Supported

H2	EEL → SA	0.224	5.807	<0.001	Supported
H3	EAA → SA	0.110	2.734	0.006	Supported
H4	DEL → SA	0.153	4.012	<0.001	Supported
H5	FEE → SA	0.179	4.354	<0.001	Supported

The structural model accounts for 44.3% of the variance in sustainability awareness (R^2=0.443), meaning that the five environmental science education approaches can be used effectively to explain students' sustainability awareness.

Overall Findings

From the results, it is evident that there is a positive relationship between environmental science education practices and sustainability awareness among university students. Specifically, curriculum integration and experiential learning play an essential role in this regard; sustainability awareness increases with the embedding of environmental concepts in academic learning and practice. The contributions of digital environmental learning and faculty involvement are equally vital in confirming the relevance of contemporary communication and the role of educators.

Overall, the empirical model confirms the hypothesized theoretical model; more environmental science education practices lead to increased sustainability awareness. The results are consistent with prior research findings that stress the significance of environmental education, student involvement, sustainable institutions, and practical environmental learning in sustainability-focused higher education.

Discussion

The results confirm that there exists a significant positive association between the use of environmental science education and sustainability awareness among the students of higher education institutions. The existence of all five suggested associations confirms that the level of sustainability awareness depends on several educational aspects and not one single learning process. Specifically, the Environmental Curriculum Integration showed the greatest significance, meaning that constant exposure to sustainability ideas through academic curricula can help students get better insights into the problems of the environment. Such a result corresponds with the current trends of sustainable education and institutional development within higher education institutions (Yarime et al., 2012; Obrecht et al., 2022; Žalėnienė & Pereira, 2021). Notably, Environmental Awareness Activities (EAA) yielded the smallest effect size ($\beta = 0.110, p = 0.006$). This indicates that co-curricular events and campaigns have a lower relative impact on long-term sustainability awareness compared to formal curriculum integration ($\beta = 0.259$) and direct experiential application ($\beta = 0.224$).

Additionally, experiential environmental learning proved a strong positive impact on the level of sustainability awareness. Participation in practical actions, environmental projects, and using their classroom knowledge can assist the students in establishing the connection between theory and reality in the field of environment. Such a result is confirmed by previous studies where practical sustainability exercises and involvement of students were proven to increase their environmental awareness (Haque et al., 2023; Benzehaf et al., 2025). Also, the significant contribution of environmental awareness activities means that campaigns, programs, and other sustainability efforts can influence environmental awareness of the students (Sevim & Pala, 2026; Dagiliūtė & Liobikienė, 2015).

An important implication arising from the significant impact of digital environmental learning is the increased use of digital means in sustainability education. This would make available for the learners the required environmental knowledge and even facilitate their continued involvement outside the traditional classroom settings (Hamid et al., 2017). Equally, the contribution of the Faculty Environmental Engagement to sustainability awareness underscores the fact that teachers play a key role in addressing environmental issues through classroom discussion and even taking part in sustainability programs (Christie et al., 2015; Alkhayyal et al., 2019). All these findings confirm the fact that sustainability education needs a holistic approach (Zsóka et al., 2013; Aldawsari et al., 2025; Boca & Saraçlı, 2019).

Limitations and Future Research

There are various limitations associated with this research. First, the cross-sectional design restricts causal inferences regarding long-term changes in awareness. Second, reliance on self-reported survey data introduces

social desirability bias. Third, the model excludes key psychological constructs such as environmental attitudes, personal values, and direct pro-environmental behavior.

In future studies, longitudinal and experimental approaches can be used to explore the impact of environmental education on sustainability consciousness over time. Research can also involve comparing students from various disciplines and levels of studies as well as higher education institutions. More variables, for example, environmental knowledge, attitudes toward the environment, institutional support, and pro-environmental behavior, can be used to build a more complex framework. Finally, mixed-method research, which includes questionnaires and interviews or observations, can give additional insight into the way students perceive sustainability-related education. Future research should adopt longitudinal multi-wave tracking to measure changes across a student's academic lifecycle. Methodologically, researchers should utilize a mixed-methods approach incorporating qualitative focus groups. Finally, the framework should be expanded to include moderation models assessing environmental values, institutional support, and actual behavioral outcomes.

Conclusion

In this study, the role of educational environmental science practices in the formation of sustainability awareness among students in higher education was assessed. The results show that the application of environmental education practices, taken altogether, is contributing significantly to the formation of sustainability awareness among students. The results of the structural analysis revealed an R^2 value of 0.443, which means that Environmental Curriculum Integration, Experiential Environmental Learning, Environmental Awareness Activities, Digital Environmental Learning, and Faculty Environmental Engagement as a set of variables contribute approximately 44.3% to the explanation of the variance of Sustainability Awareness. Of all the analyzed variables, environmental curriculum integration showed the greatest positive influence on sustainability awareness ($\beta=0.259$, $t=6.656$, $p<0.001$), while the second greatest one belongs to experiential environmental learning ($\beta=0.224$, $t=5.807$, $p<0.001$). As a result, all five hypotheses have been proved right. Internal consistency was also proved, as Cronbach's alpha varied between 0.904 and 0.947 for the examined constructs. In general, the results indicate that sustainability awareness of the students can be increased at higher education institutions by introducing environmental concepts into curriculums, giving practice-based learning experiences, engaging in awareness activities, making use of digital learning tools, and actively involving faculties. Therefore, it becomes evident that a holistic approach should be taken in teaching environmental science to make students ready to face sustainability challenges.

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