Assessing the Relative Effectiveness of Classroom-Based and Experiential Outdoor Environmental Education in Promoting Pro-Environmental Behavior among University Undergraduates in Sri Lanka

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ABSTRACT

Environmental education plays a crucial role in fostering environmental awareness, positive attitudes, and pro-environmental behavior among university undergraduates. This study aimed to compare environmental attitudes and self-reported pro-environmental behavior among Sri Lankan university undergraduates exposed to classroom-based and experiential outdoor environmental education. A quantitative, cross-sectional comparative survey design was employed, involving 250 undergraduates equally distributed between classroom-based (n = 125) and experiential outdoor education (n = 125) groups. Data were collected using a structured questionnaire and analyzed using descriptive statistics, independent-samples t-tests, and Pearson correlation in IBM SPSS Statistics. The results revealed significantly higher self-reported pro-environmental behavior among students in the experiential outdoor education group compared with the classroom-based group ($t(248) = -6.300$, $p < 0.001$, Cohen's $d = 0.80$). Similarly, students in the outdoor education group demonstrated significantly more positive environmental attitudes ($t(248) = -6.342$, $p < 0.001$, Cohen's $d = 0.80$). Furthermore, a statistically significant positive correlation was identified between environmental attitudes and pro-environmental behavior ($r = 0.593$, $p < 0.001$), indicating that more favorable environmental attitudes were associated with stronger reported environmentally responsible practices. Both group differences demonstrated large standardized effect sizes, highlighting their practical significance. However, the cross-sectional design, reliance on self-reported measures, and absence of documented random assignment limit causal interpretation. Potential social desirability bias, pre-existing environmental interests, and unmeasured demographic or educational confounders may have influenced the observed differences. Moreover, the analyses statistically adjust for factors such as gender, academic discipline, socioeconomic background, or previous environmental exposure. The findings suggest that experiential outdoor environmental education is associated with more favorable environmental attitudes and pro-environmental behavior among university undergraduates in Sri Lanka. Integrating experiential outdoor activities with classroom-based instruction may offer a promising approach to environmental education, although studies incorporating multivariate analyses are recommended to establish instructional effectiveness.

Keywords: Environmental education; experiential outdoor learning; classroom-based education; pro-environmental behavior; environmental attitudes; university undergraduates; Sri Lanka.

INTRODUCTION

Environmental challenges, including climate change, biodiversity loss, pollution, and the unsustainable exploitation of natural resources, have become major concerns for societies worldwide (Pannala, 2026). Addressing these challenges requires not only effective environmental policies and technological solutions but also changes in human attitudes, values, decisions, and everyday practices. Individual actions, when accumulated across communities, can contribute significantly to environmental degradation or conservation. Therefore, developing environmentally responsible behavior is an important component of achieving sustainable development. Environmental education (EE) is widely recognized as an approach for developing

the knowledge, attitudes, and skills necessary to understand environmental problems and participate in addressing them (N.M. Ardoin, A.W.Bowers, 2023). The importance of education in advancing sustainability is also reflected in Sustainable Development Goal 4, particularly Target 4.7, which emphasizes the acquisition of knowledge and skills necessary to promote sustainable development (UnitedNations, 2015).

However, the effectiveness of environmental education cannot be determined solely by examining whether learners acquire environmental knowledge or become aware of environmental problems. An equally important consideration is whether these educational experiences encourage individuals to translate their knowledge and awareness into consistent pro-environmental behavior. Pro-environmental behavior refers to actions undertaken by individuals that contribute to environmental protection or reduce their negative impacts on the natural environment. Such behaviors include waste reduction, recycling, water and energy conservation, sustainable consumption, participation in biodiversity conservation, and engagement in environmental initiatives. Although environmental education aims to encourage these practices, the relationship between environmental knowledge, attitudes, intentions, and actual behaviors is complex. (A. Kollmuss & J. Agyeman, 2002)examined this issue through their discussion of the gap between environmental awareness and pro-environmental behavior, highlighting the importance of understanding the barriers that prevent environmentally conscious individuals from acting accordingly. Similarly, (R. Portus, 2024), through a semi-systematic literature review of the environmental value action gap, highlighted the relevance of examining the relationship between environmental values, education, and actual environmental action. These perspectives indicate the need to assess environmental education not merely in terms of knowledge acquisition but also in relation to its contribution to behavioral change.

Universities represent an important setting for investigating this relationship because undergraduate students are developing professional competencies, personal values, social responsibilities, and behavioral patterns that may influence their future contributions to society. Higher education institutions can promote environmental responsibility through academic curriculums, practical learning opportunities, environmental societies, research activities, and campus sustainability initiatives. (Pannala, 2026), in their study Promoting Pro-Environmental Behavior Among University Students Through Sustainability Education and Institutional Support: A Mediated Moderation Model, demonstrated the relevance of sustainability education to environmental intentions and behaviors among university students. Their findings indicated that sustainability education significantly strengthened environmental intentions and pro-environmental behavior, with psychological commitment to environmental values playing an important mediating role. The authors also emphasized that institutional support can help translate environmental intentions into action. These findings suggest that environmental education within higher education should be examined in relation to the ways students develop environmental responsibility and put sustainability principles into practice (Pannala, 2026).

Nevertheless, environmental education can be delivered through different pedagogical approaches, and these approaches may not influence student behavior in the same way. Two particularly relevant approaches are classroom-based environmental education and experiential outdoor environmental education. Classroom-based environmental education generally involves lectures, presentations, academic discussions, case studies, and other structured learning activities through which students acquire theoretical knowledge and develop an understanding of environmental issues. In contrast, experiential outdoor environmental education involves active engagement with natural environments and practical environmental activities, such as field visits, biodiversity surveys, tree planting, waste separation, environmental monitoring, and community-based conservation initiatives. Although both approaches aim to develop environmental understanding and responsibility, their relative effectiveness in encouraging pro-environmental behavior requires further examination.

Classroom-based environmental education provides a structured learning environment in which students can examine environmental concepts, scientific evidence, conservation principles, and environmental policies. Through formal instruction, students may develop the conceptual understanding required to recognize the causes and consequences of environmental problems and evaluate potential solutions. Furthermore, academic learning can introduce students to environmental legislation, sustainable resource management, and the social and economic dimensions of environmental conservation. (Jayasuriya, 2023) support the importance of integrating sustainability education into university curricula, arguing that educational interventions can

strengthen students' environmental intentions and behaviors. However, the acquisition of theoretical knowledge does not necessarily ensure that students consistently practice environmentally responsible behaviors. The environmental value–action gap discussed by (A. Kollmuss & J. Agyeman, 2002)indicates that environmental awareness alone may be insufficient to explain individual action. Consequently, it is important to investigate whether classroom-based environmental education produces behavioral outcomes comparable to those associated with more practical and participatory educational experiences.

Experiential outdoor environmental education offers an alternative approach by providing students with opportunities to engage directly with environmental issues. Rather than relying exclusively on theoretical instruction, this approach encourages learners to observe environmental conditions, participate in practical activities, reflect on their experiences, and apply their knowledge to real-world situations. (Kolb, 1984) experiential learning theory emphasizes the role of concrete experience and reflection in the learning process. In environmental education, these principles can be applied through field-based investigations, ecological observations, conservation projects, and practical resource-management activities. (Rickinson, 2001), in a critical review of research on learners and learning in environmental education, examined the evidence concerning environmental learning experiences and their educational implications. These perspectives provide a theoretical basis for investigating whether direct environmental engagement can strengthen the relationship between learning and environmentally responsible action.

Evidence from the Sri Lankan context also highlights the relevance of practical and experience-based approaches. (Pannala, 2026), in Exploring School Teachers' Perceptions and Experiences of Environmental Education in the Western Province in Sri Lanka, examined how six school teachers understood and implemented environmental education. The study identified experiential understanding, collaboration, institutional context, and implementation challenges as important themes. Teachers highlighted the value of practical activities, including field visits, observation, tree planting, and waste separation, in developing students' environmental understanding and attitudes. The study also discussed the relevance of experiential learning in relation to (Rickinson, 2001) and (Kolb, 1984). However, Pannala's research focused on teachers' experiences in school settings rather than directly comparing the behavioral outcomes of classroom-based and outdoor environmental education among university undergraduates. Its findings therefore provide contextual support for the proposed research but do not establish which approach is more effective for university students.

The importance of examining actual behavioral outcomes is further illustrated by the Sri Lankan environmental education context. (Pannala, 2026) discussed continuing challenges in translating environmental awareness into consistent environmental action and identified institutional constraints, limited resources, time pressures, and the organization of educational programmes as factors affecting implementation in schools. The study also referred to research by (E.A.C.N. Perera, 2024), which assessed environmental attitudes and behavior among secondary school students in Sri Lanka. Although these studies provide useful insights into environmental education and behavior at school level, their findings cannot automatically be generalized to university undergraduates, whose educational experiences, levels of independence, social environments, and opportunities for environmental engagement may differ. Furthermore, evidence concerning teachers' perceptions or students' environmental literacy does not directly establish the comparative effectiveness of classroom instruction and experiential outdoor learning in influencing undergraduate behavior.

(N.M. Ardoin, A.W.Bowers, 2023) provide a further basis for examining this issue by emphasizing the relationship between sustainability education, environmental intentions, psychological commitment, and actual behavior among university students. Their study recommends incorporating sustainability into university curriculum alongside experiential learning opportunities, including hands-on projects, outdoor ecology courses, environmental impact assessments, and field research. However, their principal focus was the relationship between sustainability education, psychological mechanisms, and institutional support rather than a direct comparison of classroom-based and experiential outdoor environmental education. Thus, although the existing literature supports the importance of sustainability education and practical learning, further investigation is needed to determine the relative contribution of these two approaches to pro-environmental behavior among university undergraduates in Sri Lanka.

METHODOLOGY

Research Design

This study used a quantitative, cross-sectional comparative survey design to examine differences in environm-

ental attitudes and self-reported pro-environmental behaviour between undergraduates reporting classroom-based and experiential outdoor environmental education. Data were collected through a structured questionnaire at one survey point. The manuscript does not document an intervention administered by the researchers, random allocation to educational groups, or pre-test and post-test measurements. Accordingly, the design is treated as observational rather than a randomized or quasi-experimental intervention. The term "relative effectiveness" is therefore interpreted cautiously: the analyses identify differences associated with reported educational experiences but do not establish that the educational method caused those differences.

Study Population and Sample Size

The target population consisted of university undergraduates in Sri Lanka. A total of 250 undergraduates participated in the study. The sample included 125 respondents in the classroom-based environmental education group and 125 in the experiential outdoor environmental education group. The manuscript records a total sample of 250; details of the sampling frame, participating institutions, and recruitment dates should be supplied by the authors if available, as these details are not specified in the present manuscript.

Sampling Method

The manuscript records that a random sampling method was used to select participants. However, it does not describe the sampling frame, the procedure used to generate or implement the random selection, or whether random selection was conducted separately within institutions or educational-method groups. It is also not clear whether students entered the two educational-method groups through prior course exposure, institutional arrangements, or personal choice. Random sampling of respondents should not be confused with random assignment to an educational intervention. Since random assignment is not documented, potential self-selection bias and pre-existing differences in environmental interest, motivation, academic discipline, or prior environmental exposure must be acknowledged.

Data Collection Method

Primary data were collected using a structured questionnaire developed in accordance with the research objectives and relevant literature on environmental education and pro-environmental behavior. The questionnaire collected information on respondents' demographic characteristics, experiences of classroom-based environmental education, participation in experiential outdoor environmental learning, and engagement in pro-environmental practices. The questionnaire incorporated closed-ended questions and Likert-scale statements to assess students' perceptions of environmental education and their reported environmental behaviours. The behaviours examined included waste reduction, recycling, water and energy conservation, sustainable consumption, and participation in environmental conservation activities. These measures represent respondents' self-reports rather than independently observed behaviour. Responses may therefore be affected by recall error or social desirability bias, whereby participants report behaviours they consider socially desirable. The findings should be interpreted as self-reported pro-environmental behaviour.

Data Analysis

The collected questionnaire data were organized, coded, and analysed using IBM SPSS Statistics. Descriptive statistics, including frequencies and percentages, were used to summarize respondents' demographic characteristics. Cronbach's alpha was identified as the intended measure of internal consistency, and the Shapiro–Wilk test was used to assess the distribution of the outcome scores. Independent-samples t-tests were conducted to compare environmental attitudes and pro-environmental behaviour between the two educational-method groups. Pearson correlation analysis examined the association between environmental attitudes and

pro-environmental behaviour. Statistical tests were evaluated at the 5% significance level ($p < 0.05$). Standardized mean differences (Cohen's d) were calculated from the reported independent-samples t statistics and the equal group sizes (n = 125 per group). The manuscript does not provide respondent-level data or a complete set of descriptive statistics needed to independently estimate adjusted regression or ANCOVA models. Consequently, no multivariate-adjusted estimates are reported in this revision. If the original respondent-level dataset is available, further analysis controlling for age, gender, academic discipline, year of study, and prior environmental exposure is recommended.

RESULTS

Introduction

This chapter presents the analysis and interpretation of data collected to assess the relative effectiveness of classroom-based and experiential outdoor environmental education in promoting pro-environmental behavior among university undergraduates in Sri Lanka. The analysis focuses on examining differences in pro-environmental behavior and environmental attitudes associated with the two educational approaches, as well as the relationship between environmental attitudes and pro-environmental behavior. sThe collected data were analyzed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics were employed to summarize respondents' demographic characteristics and the main study variables. Inferential statistical techniques were used to examine the research hypotheses, subject to the suitability of the data and the assumptions of the selected tests. Statistical significance was evaluated at the 5% level ($p < 0.05$).

Research hypotheses

Table 3.1. Research Hypotheses of the Study

Hypothesis	**Hypothesis Statement**
H_{01} (Null)	The mean pro-environmental behavior score of students exposed to experiential outdoor environmental education is less than or equal to that of students exposed to classroom-based environmental education.
H_1 (Alternative)	Students exposed to experiential outdoor environmental education demonstrate significantly higher mean pro-environmental behavior scores than students exposed to classroom-based environmental education.
H_{02} (Null)	The mean environmental attitude score of students exposed to experiential outdoor environmental education is less than or equal to that of students exposed to classroom-based environmental education.
H_2 (Alternative)	Students exposed to experiential outdoor environmental education demonstrate significantly higher mean environmental attitude scores than students exposed to classroom-based environmental education.
H_{03} (Null)	There is no positive linear relationship between environmental attitudes and pro-environmental behavior among university undergraduates in Sri Lanka.
H_3 (Alternative)	There is a significant positive linear relationship between environmental attitudes and pro-environmental behavior among university undergraduates in Sri Lanka.

Descriptive Statistical Analysis

Table 3.2: Summary of Valid and Missing Responses for Demographic and Educational Variables

Statistics								
		Age	gender	Year_of_Study	Discipline	Education Method	ID	Outdoor Exposure
N	Valid	250	250	250	250	250	250	250
	Missing	0	0	0	0	0	0	0

Table 3.2 presents the completeness of data for the demographic and educational variables included in the study. All 250 participant records contained valid entries for age, gender, year of study, academic discipline, education method, participant identification, and outdoor education exposure. No missing values were identified across these variables, indicating a complete dataset for the variables examined. Consequently, all 250 records were available for subsequent descriptive and inferential statistical analyses involving these variables, subject to the assumptions and requirements of the respective statistical tests.

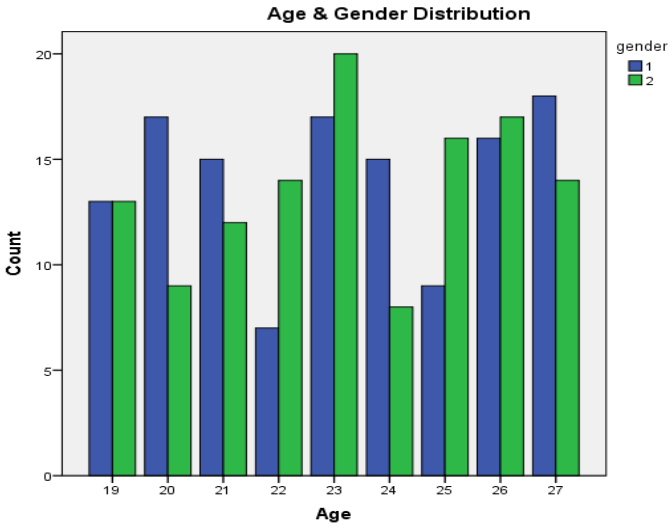
Gender Distribution of Respondents

Table 3.3 : Gender Distribution of Respondents (N = 250)

Gender					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	127	50.8	50.8	50.8
	2	123	49.2	49.2	100
	Total	250	100	100	

Table 3.3 presents the gender distribution of the 250 respondents included in the study of the total participants, 127 (50.8%) were male, while 123 (49.2%) were female, using the manuscript's coding convention that codes 1 and 2 represent male and female, respectively. The distribution indicates a relatively balanced representation of male and female respondents, with a marginally higher proportion of male participants.

Figure 3.1: Age Distribution of Respondents by Gender (N = 250)



Distribution of Respondents by Year of Study

Table 3.4: Distribution of Respondents According to Academic Year (N = 250)

Years_of_Study					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	72	28.8	28.8	28.8
	2	65	26.0	26.0	54.8
	3	59	23.6	23.6	78.4
	4	54	21.6	21.6	100.0
	Total	250	100.0	100.0	

Table 3.4 illustrates the distribution of respondents across the four academic years. First-year undergraduates represented the largest proportion of the sample (28.8%, n = 72), followed by second-year (26.0%, n = 65),

third-year (23.6%, n = 59), and fourth-year students (21.6%, n = 54). The findings indicate that all four academic years were represented in the dataset, with a gradual decline in the proportion of respondents from the first to the fourth year. This distribution provides a basis for examining educational experiences across different stages of undergraduate study.

Distribution of Respondents by Academic Discipline

Table 3.5: Distribution of Respondents According to Academic Discipline (N = 250)

Discipline					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	129	51.6	51.6	51.6
	2	121	48.4	48.4	100.0
	Total	250	100.0	100.0	

Table 3.5 presents the distribution of respondents according to their academic disciplines. Among the 250 respondents, 129 (51.6%) were classified under environment-related academic disciplines, while 121 (48.4%) belonged to non-environment-related disciplines. The distribution indicates relatively balanced representation across the two disciplinary categories. This classification provides an opportunity to examine whether academic disciplinary background is associated with differences in environmental attitudes and pro-environmental behavior.

Distribution of Respondents by Environmental Education Method

Table 3.6: Distribution of Respondents According to Environmental Education Method (N = 250)

Education Method					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	125	50.0	50.0	50.0
	2	125	50.0	50.0	100.0
	Total	250	100.0	100.0	

Table 3.6 presents the distribution of respondents according to the environmental education method. The dataset comprises 250 undergraduate participants, equally distributed between classroom-based environmental education (n = 125, 50.0%) and experiential outdoor environmental education (n = 125, 50.0%). This balanced group distribution facilitates a comparative statistical analysis of environmental attitudes and pro-environmental behavior between the two educational approaches, subject to the assumptions of the selected statistical tests.

Reliability Analysis of the Research Instrument

Case Processing Summary for Reliability Analysis

Table 3.7: Case Processing Summary for Internal Consistency Reliability Analysis (N = 250)

Case Processing Summary			
		N	%
Cases	Valid	250	100.0
	Excluded[a]	0	.0
	Total	250	100.0
a. Listwise deletion based on all variables in the procedure.			

Table 3.7 presents the case processing summary for the reliability analysis. All 250 cases (100.0%) were included in the analysis, with no cases excluded due to missing values in the selected variables. This indicates

complete data availability for the items included in the reliability assessment. Consequently, all 250 cases were retained for the calculation of Cronbach's alpha coefficient.

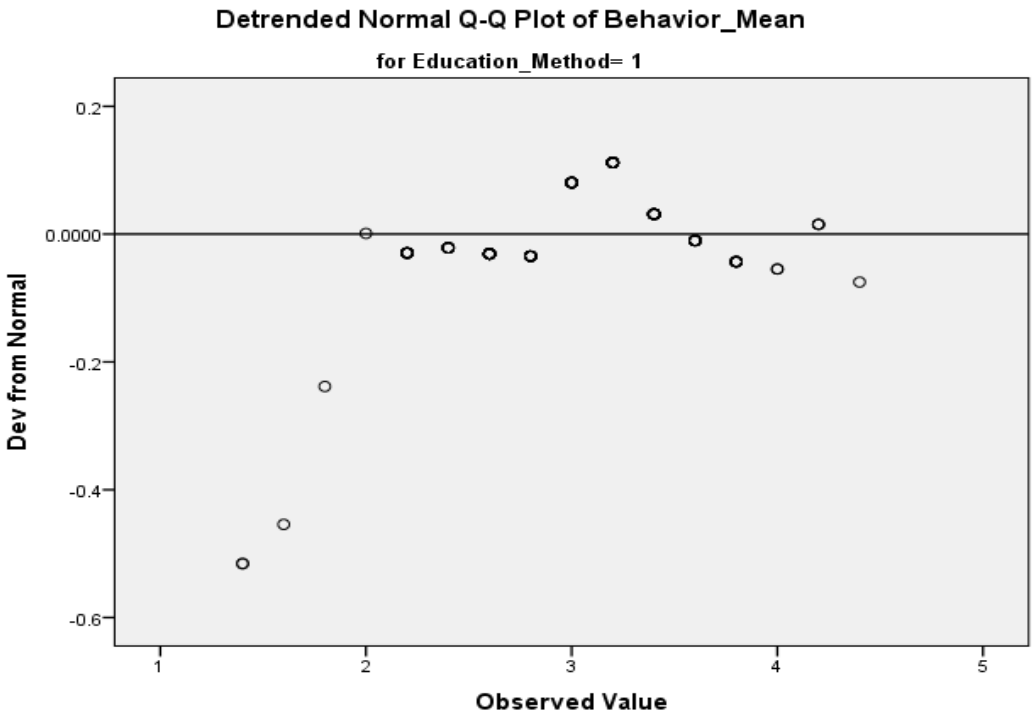
Assessment of Statistical Assumptions

Prior to conducting inferential statistical analyses, the underlying statistical assumptions were assessed to determine the suitability of the selected statistical techniques. The study employed independent-samples t-tests to examine differences in pro-environmental behavior and environmental attitudes between classroom-based and experiential outdoor environmental education groups, while Pearson's correlation analysis was selected to investigate the relationship between environmental attitudes and pro-environmental behavior.

Assessment of Normality

Table 3.8: Results of Normality Tests for Environmental Attitudes and Pro-Environmental Behavior by Educational Method (N = 250)

Tests of Normality							
	Education_Method	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Attitude_Mean	1	.097	125	.005	.980	125	.064
	2	.096	125	.007	.978	125	.039
Behavior_Mean	1	.127	125	.000	.978	125	.039
	2	.118	125	.000	.977	125	.030
a. Lilliefors Significance Correction							

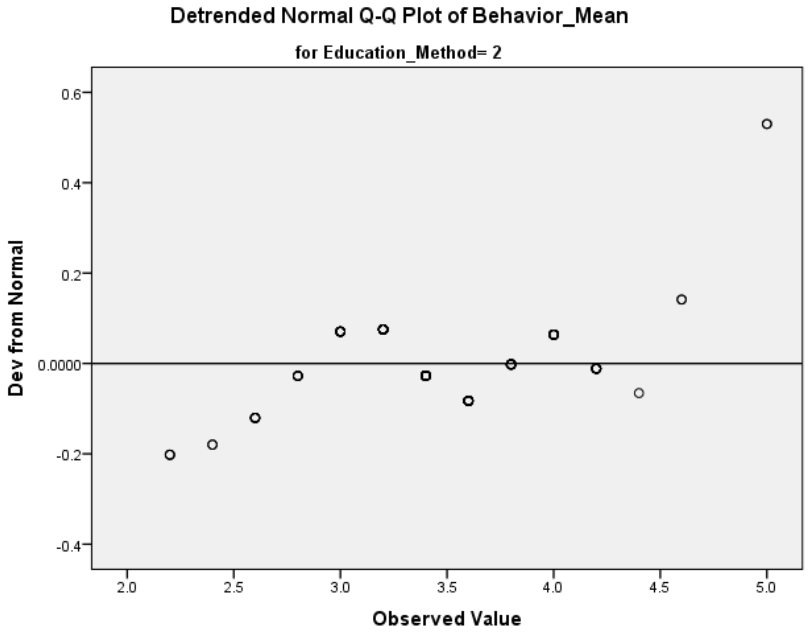


The normality tests showed that environmental attitude scores in the classroom-based group were normally distributed ($p = 0.064$), while the other three groups showed slight deviations from normality ($p < 0.05$).

Detrended Normal Q–Q Plot

The detrended normal Q–Q plot shows that most points are close to the horizontal reference line, with some deviations at lower scores. This indicates slight departures from normality in pro-environmental behavior scores among the classroom-based education group.

Figure 3.3: Detrended Normal Q–Q Plot of Pro-Environmental Behavior Scores for the Experiential Outdoor Education Group



The plot shows that most points are close to the horizontal reference line, with some deviations at higher scores. This suggests a slight departure from normality in pro-environmental behavior scores among the experiential outdoor education group.

Hypothesis Testing

This section examines the three research hypotheses using inferential statistical techniques. Independent-samples t-tests are proposed to compare pro-environmental behavior and environmental attitudes between the two educational groups, while Pearson correlation analysis is used to examine the relationship between environmental attitudes and pro-environmental behavior. Statistical significance is assessed at the 0.05 level.

Comparison of Pro-Environmental Behavior

Table 3.9: Independent-Samples t-Test Results Comparing Pro-Environmental Behavior Between Classroom-Based and Experiential Outdoor Education Groups

Independent Samples Test									
		Levene's Test for Equality of Variances		t-test for Equality of Means					
		F	Sig.	t	df	Sig. (2-tailed)	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Behavior_Mean	Equal variances assumed	1.549	0.214	-6.3	248	0	0.072	-0.592	-0.31
	Equal variances not assumed			-6.3	246.643	0	0.072	-0.592	-0.31

The independent-samples t-test revealed a statistically significant difference in pro-environmental behavior between the two educational groups ($t = -6.300$, $p < 0.001$). Levene's test confirmed that the equal variance assumption was satisfied ($p = 0.214$). The results indicate significantly higher pro-environmental behavior scores among students in the experiential outdoor education group. Therefore, H_{o1} was rejected, and H_1 was supported in the study dataset.

For equal-sized groups (n = 125 in each group), the standardized mean difference calculated from the reported t statistic was Cohen's d = 0.80, indicating a large standardized difference under commonly used interpretive conventions. This effect size is derived algebraically from the reported t statistic and group sizes; it does not involve changing or adding participant data. The negative sign of the t statistic reflects the order in which the groups were entered in the analysis, while the narrative comparison indicates higher scores in the experiential outdoor group.

Comparison of Environmental Attitudes

Table 3.10: Independent-Samples t-Test Results Comparing Environmental Attitudes Between Classroom-Based and Experiential Outdoor Education Groups

Independent Samples Test									
		Levene's Test for Equality of		t-test for Equality of Means					
		F	Sig.	t	df	Sig. (2-tailed)	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Attitude_ Mean	Equal variances assumed	.689	.407	-6.342	248	.000	.078	-.652	-.343
	Equal variances not assumed			-6.342	245.838	.000	-.498	.078	-.652

The independent-samples t-test revealed a statistically significant difference in environmental attitudes between the two educational groups ($t = -6.342$, $p < 0.001$). Levene's test indicated equal variances ($p = 0.407$). Students in the experiential outdoor education group demonstrated significantly higher environmental attitude scores than those in the classroom-based group. Therefore, H_{o2} was rejected, and H_2 was supported in the study dataset.

The corresponding standardized mean difference, calculated from the reported t statistic and equal group sizes, was Cohen's d = 0.80. This represents a large standardized difference under commonly used interpretive conventions. As with the behaviour result, the estimate is derived from the existing test statistic and sample sizes and should be checked against the original SPSS output before submission.

Relationship Between Environmental Attitudes and Pro-Environmental Behavior

Table 3.11: Pearson Correlation Analysis Between Environmental Attitudes and Pro-Environmental Behavior Among University Undergraduates

Correlations			
		Attitude_Mean	Behavior_Mean
Attitude_Mean	Pearson Correlation	1	.593**
	Sig. (2-tailed)		.000
	N	250	250

Behavior_Mean	Pearson Correlation	.593**	1
	Sig. (2-tailed)	.000	
	N	250	250
**. Correlation is significant at the 0.01 level (2-tailed).			

Pearson correlation analysis revealed a statistically significant, moderately strong positive relationship between environmental attitudes and pro-environmental behavior ($r = 0.593$, $p < 0.001$). This indicates that students with more positive environmental attitudes tend to demonstrate higher pro-environmental behavior scores. Therefore, H_{03} was rejected, and H_3 was supported in the study dataset.

DISCUSSION

The statistical analysis examined differences in pro-environmental behavior and environmental attitudes between classroom-based and experiential outdoor environmental education groups. It also investigated the relationship between environmental attitudes and pro-environmental behavior among university undergraduates.

Table 4.1: Summary of Hypothesis Testing Results

Hypothesis	**Statistical Test**	**Test Statistic**	**p-value**	**Decision**
H_1: Outdoor education is associated with higher pro-environmental behavior	Independent-samples t-test	$t(248) = -6.300$	< 0.001	Supported
H_2: Outdoor education is associated with more positive environmental attitudes	Independent-samples t-test	$t(248) = -6.342$	< 0.001	Supported
H_3: Environmental attitudes are positively associated with pro-environmental behavior	Pearson correlation	$r = 0.593$	< 0.001	Supported

The independent-samples t-test demonstrated a statistically significant difference in pro-environmental behavior between the two educational groups ($t(248) = -6.300$, $p < 0.001$). Students in the experiential outdoor education group demonstrated higher mean pro-environmental behavior scores than those in the classroom-based education group.This finding suggests that experiential outdoor education associated with stronger pro-environmental behavior among university undergraduates. Outdoor learning experiences, including field observations, ecosystem assessments, and environmental conservation activities, may provide opportunities for students to connect theoretical environmental knowledge with practical experiences. Experiential learning theory, proposed by David A. Kolb, emphasizes the role of direct experience, reflection, and active experimentation in learning. This theoretical perspective provides a possible explanation for why outdoor environmental education may be associated with stronger environmental engagement. However, the observed difference cannot independently establish that outdoor education caused higher pro-environmental behavior. Other factors, such as previous environmental exposure, academic discipline, and personal environmental interests, may also influence students' behavior.

Regarding the second alternative hypothesis, the independent-samples t-test revealed a statistically significant difference in environmental attitudes between classroom-based and experiential outdoor education groups ($t(248) = -6.342$, $p < 0.001$). The experiential outdoor education group demonstrated higher environmental attitude scores. This result suggests that students participating in outdoor environmental education may develop more positive attitudes toward environmental protection and sustainability. Direct interaction with natural environments may strengthen environmental awareness, emotional connections with nature, and appreciation of ecosystem conservation. Activities such as biodiversity observations, environmental field studies, and community-based conservation programmes may encourage students to recognize environmental challenges beyond classroom discussions. The finding is conceptually consistent with experiential learning approaches that emphasize learning through direct engagement with real-world situations. Nevertheless, classroom-based environmental education remains important for developing theoretical knowledge, scientific understanding, and critical thinking skills. Therefore, integrating classroom instruction with outdoor learning

experiences may offer a valuable approach to environmental education.

Pearson correlation analysis identified a statistically significant, moderately strong positive relationship between environmental attitudes and pro-environmental behavior ($r = 0.593$, $p < 0.001$). This finding indicates that students reporting more positive environmental attitudes also tend to report higher levels of pro-environmental behavior. The relationship is consistent with the general theoretical expectation that favorable environmental attitudes may be associated with environmentally responsible actions. The Theory of Planned Behavior developed by Icek Ajzen provides a relevant theoretical framework for understanding the relationship between attitudes, behavioral intentions, and behavior. However, environmental attitudes alone may not fully explain pro-environmental behavior. Other influences, including perceived behavioral control, social norms, access to environmental resources, and institutional support, may affect whether positive attitudes translate into actual environmental practices.

Undergraduates in the experiential outdoor education group reported higher pro-environmental behavior scores than those in the classroom-based group. The outdoor education group demonstrated more positive environmental attitudes. Also Environmental attitudes were positively associated with pro-environmental behavior. Together, these patterns illustrate how experiential outdoor environmental education could be associated with both the attitudinal and behavioral dimensions of environmental learning. From an environmental management perspective, the findings provide a useful example of how university curriculums might combine theoretical classroom instruction with practical environmental experiences. Field-based learning, ecosystem monitoring, biodiversity assessments, and community environmental initiatives may help students connect academic knowledge with environmental management challenges.

Theoretical interpretation: Theory of Planned Behavior and Value-Belief-Norm theory

The Theory of Planned Behavior (TPB) provides one framework for interpreting the positive association observed between environmental attitudes and self-reported pro-environmental behaviour. In TPB, attitudes toward a behaviour, subjective norms, and perceived behavioural control contribute to behavioural intentions, which in turn are proximal predictors of behaviour (Ajzen, 1991). The positive correlation found in this study ($r = 0.593$, $p < 0.001$) is consistent with the proposition that more favourable environmental evaluations tend to accompany stronger engagement in environmentally responsible practices. However, the present analysis measured an overall environmental-attitude score and a self-reported behaviour score; it did not separately measure subjective norms, perceived behavioural control, or behavioural intentions. The results therefore cannot be treated as a direct test of the full TPB model.

The Value-Belief-Norm (VBN) perspective offers a complementary explanation. VBN theory proposes that pro-environmental actions may be influenced by environmental values, beliefs about environmental consequences, awareness of consequences, and personal norms (Stern, 2000). Experiential outdoor activities—such as field observation, biodiversity assessment, and participation in conservation initiatives—may provide opportunities for students to connect environmental issues with their own experiences and sense of responsibility. This is a plausible interpretation of the higher attitude and behaviour scores reported by the outdoor-learning group, but the current questionnaire results do not directly test the values, beliefs, or personal-norm components of VBN. Future studies could operationalize these constructs to examine the mechanisms through which different educational experiences are associated with environmental action.

The two theoretical perspectives also help explain why positive attitudes do not invariably translate into behaviour. Even when students value environmental protection, practical action may depend on perceived control, social expectations, access to facilities, time, financial resources, and institutional support. For example, students may express support for recycling but be unable to recycle consistently if suitable campus facilities are unavailable. Universities should therefore combine educational activities with supportive campus systems and opportunities for meaningful participation.

Practical implications for Sri Lankan universities

The findings suggest that Sri Lankan universities could strengthen environmental education by integrating

structured outdoor components into existing lecture-based courses rather than treating classroom and outdoor approaches as competing alternatives. A practical model could include: (i) preparatory lectures introducing rel-

evant ecological concepts, environmental policies, and field methods; (ii) supervised field activities such as campus biodiversity surveys, water-quality observations, waste audits, and energy-use assessments; (iii) reflective assignments requiring students to connect field observations with course concepts; and (iv) follow-up student-led projects that address an identified environmental issue on campus or in a nearby community. Each activity should have clearly stated learning outcomes, risk-management arrangements, appropriate supervision, and an assessment method linked to both knowledge and practical engagement.

At the institutional level, universities could establish partnerships with local authorities, environmental agencies, community organizations, and conservation groups to provide authentic field-learning opportunities. Campus facilities should also support the behaviours promoted through teaching—for example, accessible waste-separation points, water- and energy-conservation systems, and student participation in environmental management committees. Such measures may help reduce the gap between environmental attitudes and opportunities for action. Implementation should be adapted to each institution's resources, academic calendar, location, and disciplinary context.

LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

Several limitations should be considered when interpreting these findings. First, the study used a questionnaire and self-reported behavioural measures; responses may be affected by recall error and social desirability bias and may not fully represent students' everyday actions. Second, although the manuscript states that random sampling was used, it does not document random allocation to educational groups, a pre-test–post-test design, or the process by which students received their respective educational experiences. Students with stronger prior environmental interest or greater previous exposure may have been more likely to participate in outdoor learning, creating potential self-selection and confounding. Third, the reported analyses are bivariate and do not adjust for age, gender, academic discipline, year of study, socioeconomic background, or prior environmental exposure. Although demographic variables are described, adjusted effects cannot be established from the summary statistics presented here. Fourth, the study is cross-sectional and therefore cannot establish temporal order or causality. Finally, the available manuscript does not fully describe the sampling frame or participating institutions, which limits assessment of representativeness and generalizability.

Future research should use the original respondent-level dataset to conduct multivariable linear regression, provided that the relevant variables are measured and coded appropriately. Educational method could be entered as the principal predictor, with age, gender, academic discipline, year of study, and prior environmental exposure included as covariates where available. ANCOVA would be appropriate only where a defensible baseline measure exists and the model assumptions are met. Prospective studies with pre-test and post-test measurements, and where feasible random or carefully matched group allocation, would provide stronger evidence about change attributable to educational approaches. Researchers could also complement self-reported questionnaires with behavioural observations, campus participation records, or practical environmental tasks to reduce reliance on self-report.

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