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KEYWORDS	ABSTRACT
Climate action, institutional sustainability practices, Lahore, Pakistan, HEIs, green self-efficacy, climate change education, green campus, pro-environmental behavior.	Sustainability has been transformed from a secondary concern to a top priority and strategic focus by global climate change for higher education institutions around the globe. Educational institutions are not merely the users of land, energy, water, and other resources but are also considered vital social institutions for sparking the curiosity for knowledge, behavior, skills, and attitudes in students necessary to understand and take necessary actions for climate change. In Pakistan environmental challenges are increasingly impacting education, social and economic systems; therefore, HEIs (Higher Education Institutions) of Pakistan play an important role in preparing the young generation to promptly respond to climate-related risks. Existing Pakistan research has paid much attention to students' sustainable development education, climate change thinking processes, and sustainability awareness, but it has been limited in focus on psychological mechanisms of educational institutions through which HEIs' sustainability practices can transform into real pro-environmental attitudes. This study presents an integrated framework to evaluate whether sustainability practices and climate change education in higher education institutions of Lahore affect students' pro-environmental attitudes through green self-efficacy. By employing Social Cognitive Theory and utilizing the attitudinal logic of environmental and climate change education, this study uses green self-efficacy as a psychological mechanism through which students translate environment-related learning and their institutional sustainability exposure into responsible sustainability actions. By conceptualizing a quantitative cross-sectional 5-point Likert scale questionnaire research design, the study collected data from 600 undergraduate and postgraduate students enrolled in seven (7) public and eight (8) private HEIs in Lahore. The study employed PLS-SEM (Partial Least Squares Structural Equation Modelling) to examine structural and measurement models, including direct and indirect relations among study variables. This study will contribute to the existing higher education literature and improved sustainability practices by stepping ahead from sustainability awareness approaches and elaborating on how climate education and institutions' sustainability practices can translate students' perceived knowledge into actual environmental and climate actions. The empirical results also provide practical insight to Pakistani HEIs to translate their green campus strategies and climate education into measurable and real students' action behavior.
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Introduction

Climate change is not solely an environmental challenge but an educational, organizational, economic, and social issue too. Economies with higher risks for changing rainfall patterns, floods, climate-related perils, heatwaves, and other environmentally related challenges face significant danger to human development, livelihoods, public services, and infrastructure. Pakistan remains susceptible to environmental shocks. A recent report of the World Bank assessment depicted that Pakistan continues to confront high risk of recurring floods, intense heatwaves, rapid glacial melts, and linked socioeconomic outcomes. This World Bank (2026) report also emphasized the importance of enhancing resilience across social and economic domains, including the education sector. Therefore, climate and environmental action in Pakistan not only needs policy and technological responses but also behavioral, attitudinal, and educational transformation. Higher education institutions play a vital role in this transformation. HEIs utilize a large quantity of resources through food services, buildings, energy use, waste generation, transportation, procurement, and water consumption, and at the same time, they educate and train future managers, researchers, policymakers, professionals, and community leaders. As a result, sustainability practices embraced by HEIs can act concurrently as operational mediators and as learning atmospheres. Students may gain knowledge on sustainable practices not only through traditional classroom settings but also through monitoring and taking part in water and energy-saving initiatives, waste management and energy conservation programs, tree plantation drives, green transportation, sustainable procurement, and their campus climate-related policies. The role of HEIs in sustainability cannot be denied because education can positively impact environmental behavior, attitude, competencies, intentions, and knowledge of the young generation. However, mere learning of climate change education at institutions does not inevitably promise behavioral change. Recent research on sustainability highly focuses on the need to comprehend the institutional psychological mechanisms that translate climate-related knowledge into actual pro-environmental action. Recent studies also show that students' green behavior and intentions can be influenced through institutional ecosystems, green-campus initiatives, environmental support structures, and sustainability systems (Chen *et al.*, 2025). Similarly, psychologically green environment of an education institution can positively impact the pro-environmental behavior of the students through sustainable psychological mechanisms and green self-efficacy (Nguyen & Nguyen, 2025).

The Pakistani context domain is still underserved in this area. In Pakistani HEIs both public and private, sustainable development education remained inadequately implemented, and more focus is required at the undergraduate level for sustainability education (Saqib *et al.*, 2020). Recent research investigated climate change perceptions and sustainable development from 400 UET Lahore University of Punjab students and found limited curriculum coverage of these concepts with weaker perceptions of sustainable development than climate change (Nadeem & Nawaz, 2022). These researches depict the importance of sustainability, environmental and climate change education in Lahore but leave a question unresolved: How do an education institution translate its campus sustainability practices and climate-related education into students' pro-environmental behavior? This question carries weight because attitude and awareness are not synonyms. A

student may learn about climate change at an educational institution but still lack the opportunities, confidence, institutional encouragement, and resources to act. This problem can be addressed using green self-efficacy which is a theoretically applicable mechanism. Self-efficacy is the belief of an individual in his/ her abilities to organize and implement actions necessary to acquire desired consequences (Bandura, 1986). Green self-efficacy strengthens a student's belief that he/ she can successfully implement environmentally responsible actions ((Nguyen & Nguyen, 2025).

The present study presents a unified conceptual model linking HEIs climate change education and sustainability practices with students' pro-environmental behavior through green self-efficacy. The study takes students as potential climate-action agents rather than passive receivers of sustainability and climate information, whose behavior may be changed by the interplay between HEIs psychological capability and educational environment with educational experience.

Research Gap

Three gaps encourage the present study: (i) Much research work in Pakistani HEIs has examined general sustainability implementation and environmental awareness perceptions (Sagib *et al.*, 2020; Nadeem & Nawaz, 2022) however, this research do not explain the institutional psychological mechanism through which campus sustainability practices can be transformed into real pro-environmental behavior of the students in Pakistani HEIs. (ii) Recent international studies acknowledge the importance of campus sustainability practices in changing students' environmental and climate change perceptions (Chen *et al.*, 2025). The study was conducted in China, but the degree to which such relationships work within the educational and socioeconomic atmosphere of Lahore Pakistan, inadequately supported. (iii) Green self-efficacy is considered a vital mechanism connecting campus environmental climates to student perception; it also acts as a mediator between the institution's psychological sustainability practices and students' pro-environmental attitudes (Nguyen & Nguyen, 2025). However, this relationship has not been sufficiently incorporated with campus sustainability practices and environmental education in HEIs of Pakistan. The present study addresses these gaps by investigating incorporated institutional-psychological-educational pathways in HEIs of Lahore, Pakistan.

Research Objectives

The study seeks to: (i) investigate the impact of campus sustainability practices on pro-environmental behavior of undergraduate and graduate students of HEIs in Lahore. (ii) evaluate the impact of climate change education on pro-environmental perceptions of students. (iii) examine whether green self-efficacy of students is influenced due to sustainable practices in education institutions (iv) examine whether green self-efficacy of students is influenced due to climate change education (v) evaluate the impact of green self-efficacy on pro-environmental attitude of the students. (vi) examine how green self-efficacy intervenes in the relationships between climate change education, sustainable practices at HEIs of Lahore, and pro-environmental perceptions of undergraduate and graduate students.

Literature Review

Sustainable Practices in HEIs

Sustainable practices at higher education institutions refer to the operational activities, programs and policies, infrastructures and systems through which a HEI incorporates environmental sustainability into campus life and institutional management. Such sustainable practices may comprise green buildings, tree plantation drives, recycling and waste management, renewable energy, plastic-free campuses, green procurement, water conservation, sustainable transportation, and eco-friendly campus initiatives. Universities influence their students through formal and informal learning. Students feel environmentally responsible when sustainability practices are visible in the campus environment. A higher education institution with water-saving initiatives, recyclable dustbins, tree plantation drives, green buildings, and green transportation provides platforms to the students that can make sustainable practices more effortless and acceptable. Chen *et al.* (2025) investigated campus ecosystem, support system, sustainability system, and campus green initiatives and found positive results with students' green perceptions, which consequently affect their green behavior. The study further explained that along with traditional classroom climate change education, education institutions should develop campus environments in which sustainable practices are actionable and visible. For strengthening sustainable practices, higher education institutions are working on transformative learning, collaboration, campus leadership, and policy and governance related to sustainable practices. Still, climate change education and resilience are undiscovered areas in HEIs' sustainability domain (Ogbolu *et al.*, 2026). Research in the Pakistani context has identified various institutional hurdles to sustainable practices implementation, including constraints on campus resources, implementation and policy mechanisms, and institutional capacity for such practices. Such obstacles underscore why academic settings are important for analyzing pro-environmental behavior of students (Shaheen *et al.*, 2024).

Climate Change Education

It refers to teaching-learning processes through which knowledge of climate risks, climate science, resilience, adoption, climate action, sustainability practices, and environmental responsibility is developed in students. Climate change education extends beyond the traditional classroom knowledge. It builds capacity to practically implement climate change knowledge, participate in climate action decision-making, and evaluate workable solutions. Universities are an important medium to disseminate climate change education, as they prepare students to step into various fields such as economics, technology, politics etc., as professionals. Climate education therefore, can become an important factor of professional expertise. Research in Lahore Pakistan, has shown that although students have awareness of sustainable practices and climate change, they lack the practical implementation of both. Therefore, HEIs' curriculum needs integrated experiential learning (Saqib *et al.*, 2020; Nadeem & Nawaz, 2022). The effectiveness of climate change education cannot be measured only through knowledge acquisition. It is the need of the hour to translate students' climate information and environmental knowledge into pro-environmental students' behavior (Hijazi *et al.*, 2025).

Green Self-Efficacy

Self-efficacy is an individual's belief in their competency to plan and execute actions necessary to acquire desired consequences. It is a main concept in Social Cognitive Theory (Bandura, 1986). In environment and climate action domains, green self-efficacy refers to an individual's perceived competency to participate in environmentally and climate-responsible actions. This concept is important because climate change behavior often involves practical implementation and challenges. An undergraduate or graduate student may believe that a plastic-free campus is desirable but may doubt personal contribution. Similarly, a student may understand the importance of water and energy conservation but face campus constraints in practical implementation. Green self-efficacy builds perceived competency in students to face sustainability and climate change challenges in the real world and develop workable solutions for them. Green self-efficacy also acts as a mediator between institutional psychological green climate and students' pro-environmental behavior in HEIs. It means that educational institutions' climate change education does not directly produce behavior; it is mandatory for them to first influence the behavior of their students about their competency to practically act in real-world environments (Nguyen & Nguyen, 2025). This study takes green self-efficacy as a psychological mediator between HEI's environment and students' perceived behavior.

Pro-Environmental Behavior

Pro-environmental behavior refers to individuals' actions taken to minimize negative environmental impact or protect natural climate systems. In HEIs context, it may include waste management, water and energy conservation, plastic-free campus, green transport, tree plantation drives, conserving other natural resources, and motivating others to participate in environmentally responsible and sustainable practices. Pro-environmental behavior is an important consequence as it translates climate change education into pro-environmental students' behavior. Real implementation of traditional classroom knowledge about climate change converts into experiential learning with fieldwork and sustainable practices. Psychological and social factors are important in shaping environmental behavior, as behavioral control, subjective norms, campus culture, and attitudes add to pro-environmental students' behavior related to climate change (Butt *et al.*, 2019). Recent international research has now switched towards comprehending how HEI's environment and psychological competencies translate classroom climate change education into actual actionable behavior. The present study takes pro-environmental behavior as the principle dependent variable rather than climate change awareness.

Theoretical and Conceptual Framework

Social Cognitive Theory

SCT (Social Cognitive Theory) of Bandura is the key theoretical foundation of this research, and refers to the fact that individual actionable behavior develops through interactions among personal behavior, environmental and climate influences, and personal factors (Bandura, 1986). In the context of HEIs sustainability research, this theoretical viewpoint is particularly relevant

because university students stay during their educational period in a strong campus environment; campus life, their own beliefs on what they can do, what they already know, and what they observe about others' participation and opportunities and challenges created by their campus environment have the capacity to influence their behavior. In the proposed model of the study: (i) HEIs sustainable practices refer to an environmental influence. (ii) Climate change education is cognitive/ educational influence. (iii) Green self-efficacy is an individual psychological mechanism, and (iv) Pro-environmental behavior is the behavioral outcome. The study model represents the basic social cognitive theory logic: Environment + Learning → Self-Efficacy → Behavior. HEIs that provide climate education, environmental initiatives, green transportation, waste management infrastructures, and various opportunities for other sustainable practices may strengthen pro-environmental behavior of their students. Green self-efficacy should thereafter enhance pro-environmental behavior. The present study utilizes climate change education literature, which develops values, knowledge, skills, attitudes, opportunities, and capabilities for workable action rather than simply transferring knowledge to the students. Climate change education interacts with education institution support systems in shaping students' behavior (Chen *et al.*, 2025). The proposed framework of this study therefore incorporates psychological and educational perspectives rather than considering climate change education merely an independent variable.

Study Hypotheses

In HEIs, climate change education and sustainable practices present two interdependent environmental impacts. Sustainable practices at campus provide an actionable context in which change in sustainable behavior can be observed and influenced, whereas climate change education develops understanding in students about environmental challenges and possible actionable responses. These two environmental impacts may therefore strengthen confidence in students to implement sustainable practices in the real-world and directly influence students' pro-environmental behavior. The present study adopts a more frugal hypothesis framework and focuses on the overall explanatory role of HEIs' climate change education and sustainable practices and investigates green self-efficacy as a mediating psychological mechanism.

Sustainability Practices, Climate Change Education and Pro-Environmental Behavior

HEIs provide physical and social environments to their students in which they observe and participate in campus, such as sustainability practices. Sustainable practices at campus as tree plantation drives, water and energy conservation, waste management system initiatives, plastic-free campus campaigns, etc. minimize practical obstacles linked with students' environmentally responsible behavior while disseminating those sustainable practices are expected and accepted as an aspect of campus life. Social cognitive theory explains that institutions function as an environmental source to change students' attitudes, reinforcement, and experiential learning. When students get the opportunity to participate in real-world sustainable practices, environmentally responsible behavior develops in them. Green campus initiatives and

sustainability initiatives directly influence students' pro-environmental behavior (Frizon *et al.*, 2024; Chen *et al.*, 2025). HEIs curriculum, policies, extracurricular activities, and their commitment to sustainable practices positively influence students' pro-environmental behavior (Irfana *et al.*, 2026). The results are specifically relevant to the HEIs of emerging economies because their sustainability practices and efforts have the capacity to change students' behavior for climate and environment. Action-oriented knowledge in HEIs is vital because it converts classroom concepts into experiential learning, but HEIs of Pakistan are lacking in it (Nadeem & Nawaz, 2022). Sustainable development education is associated with students' pro-environmental behavior, and green self-efficacy acts as a psychological mediator through which classroom concepts are translated into attitude (Zhang & Cao, 2025). These arguments propose that both campus environment and students' educational exposure add value to students' pro-environmental behavior. Therefore,

H1: Climate change education and HEI's sustainable practices have a notable and positive impact on students' pro-environmental behavior.

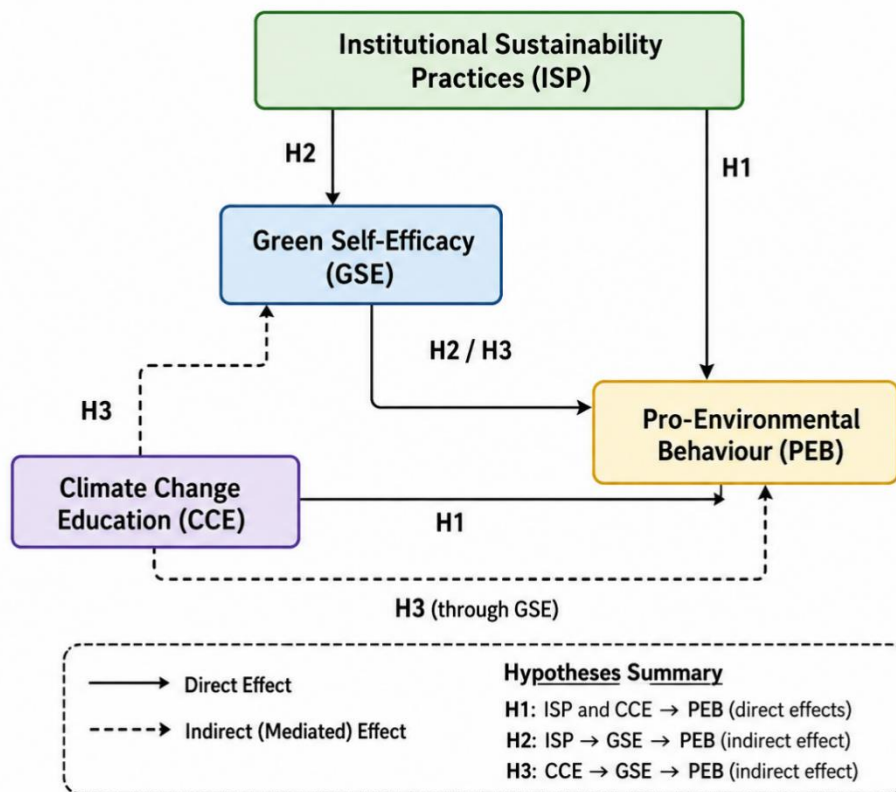
Green Self-Efficacy as a Psychological Mechanism

Climate change education and sustainable practices at higher education institutions directly influence students' pro-environmental behavior. Social cognitive theory defines that institutional environment conditions influence students' beliefs about their competency to act on relevant behavior, and among these beliefs, self-efficacy is the central belief, as it persists in attitudes (Bandura, 1986). Green self-efficacy is the confidence of the students in their capability to perform actions that are environmentally responsible and participate effectively and efficiently for environmental betterment. Education institutions can enhance this belief by providing them experiential learning. A student who engages in a campus recycling campaign, participates in a tree plantation drive, conducts a waste assessment, or executes an energy-saving plan will receive experiential learning that environmental action is capable of being done. This experiential learning will also enhance the perceived competency and belief of the student, and he/she will be repeatedly engaging in such sustainable practice even beyond his/ her campus settings. Research shows that HEIs' experiential climate change education has a direct relationship with students' pro-environmental and green self-efficacy, strengthens this relationship (Nguyen and Nguyen, 2025). The findings further show that through this internal psychological mechanism students' classwork taught climate change concepts can be converted into a pro-environmental behavior. Pro-environmental behavior of students is promoted by pro-environmental institutional climate, with green self-efficacy strengthening this relationship (Han *et al.*, 2026). Green self-efficacy acts as a mediator between students' pro-environmental behavior and sustainable development education (Zhang & Cao, 2025). The findings of previous research suggest that green self-efficacy is a bridge between students' pro-environmental behavior and educational/ contextual impacts. Climate change education can provide knowledge, but sustainable practices at campus create opportunities for experiential learning for the students and make them environmentally responsible. Therefore, the present study proposes these theoretically linked relationships into the discussion framework:

H2: Green self-efficacy acts as a mediator between HEIs' sustainable practices and students' pro-environmental behavior.

H3: Green self-efficacy acts as a mediator between climate change education and students' pro-environmental behavior.

These three hypotheses' structure provides a leaner model; particularly, the model suggests that climate change education and campus sustainable practices are important components of students' pro-environmental behavior, while green self-efficacy defines how these HEIs' environmental influences can be translated into students' pro-environmental behavior. This model is explained with a diagram below:



This structural model is consistent with Chen et al. (2025) as sustainable practices at HEIs are directly linked with students' pro-environmental behavior, and Han et al. (2026) as green self-efficacy moderates the relationship between pro-environmental students' behavior and pro-environmental institutional climate. Zhang and Cao (2025) also found that green self-efficacy makes a link between HEIs sustainability practices, climate change education, and students' pro-environmental behavior. These researches also support that education creates influence only when

it is attached to experiential learning. This proposed conceptual framework of this study contains two indirect mediated effects and two direct effects. The direct effects represent the expected overall impact of sustainable practices at HEIs and climate change education on students' pro-environmental behavior. The indirect effects encompass the scope to which these effects work through green self-efficacy. This framework is theoretically justified and appropriate for higher education because green self-efficacy is an important concept of social cognitive theory through which both educational and environmental sustainability practices' impact can be translated into pro-environmental behavior of HEIs students.

Data and Methodology

The study employed a deductive approach with quantitative research design and positivist research philosophy. The positivism research approach is suitable because the study aims to empirically investigate the relationships among measurable constructs. The study adopted a cross-sectional survey design and collected data from 600 students at one point in time from seven (7) public and eight (8) private universities of Lahore Pakistan, through a structured questionnaire using a 5-point Likert scale (1= Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree, and 5= Strongly Agree). Sample size is consistent with Hair *et al.* (2021), according to them, sample size requirements in PLS-SEM (Partial Least Squares Structural Equation Modeling) are determined using power-based guidelines such as target R^2 values or the inverse square root method rather than the outdated 10-times rule. This research design is consistent with Chen *et al.* (2025) including recent climate change education and sustainability research among students of HEIs using PLS-SEM and cross-sectional survey data. The study considered all undergraduate and graduate students enrolled in private and public HEIs in Lahore as its target population. Data collection from both public and private HEIs improved institutional diversity and allowed the study to catch variation in curriculum, sustainability practices and policies, students' experience, and campus infrastructure. Furthermore, the study utilizes a multi-stage sampling strategy; first, HEIs of Lahore were categorized as public and private sectors; second, data was collected from selected HEIs (Public sector universities: 1. University of Punjab 2. UET Lahore 3. GCU Lahore 4. University of Education 5. LCWU 6. Information Technology University 7. King Edward Medical University; Private sector universities: 1. University of Management and Technology, Lahore 2. LUMS 3. University of Central Punjab 4. University of Lahore 5. Forman Christian College University 6. Superior University 7. Beaconhouse National University 8. Lahore School of Economics), and thirdly, students were sampled using purposive sampling. A pilot test of 100 students was conducted to check the validity and reliability of the questionnaire.

Construct of Responses

Table 4.1 below explains the variables and constructs of responses (Institutional Sustainability Practices= ISP; Climate Change Education= CCE, Green Self-Efficacy= GSE and Pro-Environmental Behavior= PEB).

Table 4.1: Variables and Constructs of Responses

Variables and Constructs of Responses		
Institutional Sustainability Practices (ISP) – Independent Variable		
Variable	Statement	Consistent with
ISP1	My university actively promotes environmental sustainability on campus.	Chen <i>et al.</i> (2025)
ISP2	My university has effective systems for managing waste.	
ISP3	My university takes measures to reduce unnecessary energy consumption.	
ISP4	My university promotes responsible use and conservation of water.	
ISP5	My university provides facilities or initiatives that encourage environmentally friendly transportation.	
ISP6	My university regularly organizes environmental or sustainability-related activities for students.	
ISP7	Sustainability considerations are incorporated into university policies and operations.	
ISP8	My university provides students with opportunities to participate in environmental decision-making or sustainability projects.	
Climate Change Education (CCE) – Independent Variable		
CCE1	My university provides sufficient opportunities to learn about climate change.	Sagib <i>et al.</i> (2020) and Nadeem and Nawaz (2022)
CCE2	Climate change issues are incorporated into courses or academic activities at my university.	
CCE3	My university helps students understand the causes of climate change.	
CCE4	My university helps students understand the local impacts of climate change.	
CCE5	My university provides information about climate change mitigation and adaptation.	
CCE6	My university encourages students to participate in practical climate-action activities.	
CCE7	My university encourages students to develop practical solutions to environmental problems.	
Green Self-Efficacy (GSE) – Mediator		
GSE1	I am confident that I can reduce the environmental impact of my daily activities.	Nguyen and Nguyen (2025)
GSE2	I am confident that I can adopt environmentally friendly practices even when they require additional effort.	
GSE3	I am capable of finding ways to behave more environmentally responsibly.	
GSE4	I feel capable of encouraging other students to adopt environmentally friendly behaviors.	
GSE5	I am confident that my environmental actions can make a positive contribution.	
GSE6	I can successfully participate in activities aimed at solving environmental problems.	
Pro-Environmental Behavior (PEB) – Dependent Variable		
PEB1	I switch off lights or electrical devices when they are not needed.	Chen <i>et al.</i> (2025) and Nguyen and
PEB2	I avoid wasting water.	

PEB3	I dispose of waste in the appropriate bins.	Nguyen (2025).
PEB4	I reuse or recycle materials whenever possible.	
PEB5	I avoid unnecessary use of single-use plastic items.	
PEB6	I participate in environmental or sustainability activities at my university or in my community.	
PEB7	I encourage my friends or classmates to behave in environmentally responsible ways.	
PEB8	I make an effort to choose environmentally friendly alternatives when possible.	

Methodology

The study employed the following empirical methodologies: 1. Data screening to check the completeness and quality of 600 responses. 2. Outliner analysis to check unrepresentative observations. 3. Descriptive Statistics to examine means, standard deviations, skewness, and kurtosis. 4. Common Method Bias (CMB) Assessment to evaluate potential bias arising from collecting criterion and target measures through the same questionnaire. 5. PLS-SEM is the main methodology to test the structural and measurement models. 6. Measurement Model Assessment to examine the quality of the constructs. 7. CFA (Confirmatory Factor Analysis) to investigate the relationships between indicators and their respective constructs. 8. Indicator Loadings to examine indicator reliability. 9. Cronbach Alpha to examine the internal consistency reliability. 10. CR (Composite Reliability) to test construct reliability. 11. AVE (Average Variance Extracted) to examine convergent validity. 12. HTMT (Heterotrait-Monotrait Ratio) to test discriminant validity. 13. VIF (Variance Inflation Factor) to examine multicollinearity. 14. Structural Model Assessment to evaluate hypothesized relationships among CCE, GSE, ISP and PEB. 15. Path-Coefficient Analysis to assess the direction and strength of hypothesized relationships. 16. R² (Coefficient of Determination) to estimate the variance explained in endogenous constructs. 17. F² (Effect-Size Analysis) to estimate the contribution of individual predictors. 18. Q² (Predictive-Relevance Analysis) to determine the predictive relevance of the structural model. 19. Bootstrapping to evaluate confidence intervals and significance of path coefficients and 20. Mediation Analysis to evaluate whether green self-efficacy intervenes in the relationships between CCE, ISP and PEB.

Empirical Results

This section explains the empirical findings of the study. The study used SPSS and SmartPLS 4 to estimate the results.

Data Screening Results

Table 5.1: Missing Value and Outlier Analysis

Test	Result	Decision
Total respondents	600	Retained
Total item responses	17400	---

Missing values	0	---
Duplicate response patterns	0	---
Univariate outliers	z	> 3.29
Multivariate outliers (Mahalanobis, $p < 0.001$)	0	No problematic outliers
Final sample	600	Retained all responses

Data screening was conducted using 600 responses. Invalid or no responses were already removed. The results show that study data has no missing values; therefore, no responses require deletion. Univariate outliers' results indicate no observations exceeding the ± 3.29 acceptable range. Mahalanobis distance assessment similarly did not indicate any multivariate outliers at the $p < 0.001$ level. Therefore, 600 responses were retained for further statistical analysis.

Demographic Profile of Respondents

Table 5.2: Demographics

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	311	51.8
	Female	277	46.2
	Prefer not to say	12	2.0
Age	18-20	133	22.2
	21-23	309	51.5
	24-26	103	17.2
	27 or above	55	9.2
Study Level	Undergraduate	440	73.3
	Master's/ MPhil	134	22.3
	PhD	26	4.3
Year/ Semester	1 st year	129	21.5
	2 nd year	116	19.3
	3 rd year	106	17.7
	4 th year	124	20.7
	5 th year or above	125	20.8
Institution Type	Public	266	44.3
	Private	334	55.7
Academic Discipline	Medical/ Health Sciences	101	16.8
	Business/ Management	95	15.8
	Computer Science/ IT	91	15.2
	Engineering/ Technology	88	14.7
	Social Sciences	73	12.2
	Education	60	10
	Natural/ Environmental Sciences	48	8
	Other	44	7.3

Climate/ Course	Sustainability	Yes	330	55
		No	126	21
		Not Sure	144	24
Environmental Participation	Activity	Yes	347	57.8
		No	253	42.2

The results of demographics indicate that female students' participation is higher with 311 responses (51.8%) than male students with 277 responses (46.2%), while 12 responses (2.0%) were obtained from the gender not to disclose. Regarding age, the highest responses, i.e., 309 responses (51.1%) were obtained from age group of 21-23 years, 133 responses (22.2%) from 18-20 years, 103 responses (17.2%) from 24-26 years and 55 responses (9.2%) from 27 or above age group. Regarding study level, 440 high responses (73.3%) were obtained from undergraduate students, 134 responses (22.3%) from Master's/ MPhil students and 26 responses (4.3%) from PhD students. While 129 high responses (21.5%) were from 1st year students, 125 responses (20.8%) were from 5th year students, 124 responses (20.7%) from 4th year students, 116 responses (19.3%) from 2nd year students and 106 responses (17.7%) from 3rd year students. While participation in private sector was high with 334 responses (55.7%) and then 266 responses (44.3%) from public sector. Students from the discipline Medical/ Health Sciences have highest contribution with 101 responses (16.8%) followed by Business/ Management with 95 responses (15.8%), Computer Science/ IT with 91 responses (15.2%), Engineering/ Technology with 88 responses (14.7%), Social Sciences with 73 responses (12.2%), Education with 60 responses (10%), Natural/ Environmental Sciences with 48 responses (8%) and other disciplines 44 responses (7.3%). 330 students responded (55%) that they have access to climate change education, 126 students (21%) reported that no such course is being offered at their campus, and 144 students (24%) were unsure. Furthermore, 347 students responded (57.8%) that they participated in environmental/ sustainability activity at their campus, while 253 students (42.2%) have not participated in any such activity. The overall demographic results show that students responded from diverse educational levels, disciplines, genders, age groups, and institutional types, providing a suitable basis for evaluating climate change education, green self-efficacy, institutional sustainability practices, and students' pro-environmental behavior.

Descriptive Statistics

Table 5.3: Descriptive Statistics and Normality Assessment

Variable	Items	Mean	S.D	Skewness	Kurtosis	Min.	Max.
Institutional Sustainability Practices (ISP)	8	3.246	0.858	-0.054	-0.764	125	5
Climate Change Education (CCE)	7	3.177	0.909	-0.067	-0.678	1	5
Green Self-Efficacy (GSE)	6	3.224	0.911	-0.065	-0.712	1	5
Pro-Environmental Behavior (PEB)	8	3.289	0.912	-0.227	-0.645	1	5

The results of descriptive statistics show the moderate levels of PEB, GSE, ISP and CCE. The mean scores are 3.246 for institutional sustainability practices, 3.177 for climate change education, 3.224

for green self-efficacy, and 3.289 for pro-environmental behavior, while the corresponding standard deviations are 0.858, 0.909, 0.911 and 0.912 respectively. Skewness values range from -0.227 to -0.054 whereas kurtosis values range from -0.764 to -0.645 showing no serious departure from the acceptable range. All values fall within the acceptable range.

Common Method Bias

Table 5.4: Common Method Bias Assessment

Assessment	Result	Criterion	Decision
Harman's single-factor test	30.67%	< 50%	No serious CMB
Number of indicators	29	---	---
First unrotated factor	30.67%	< 50%	Acceptable

CMB (Common Method Bias) was estimated using Harman's single-factor approach. The first unrotated factor is 30.67% of total variance, which is considerably below the 50% level thus, CMB does not appear to be a serious concern in the study data.

Measurement Model Assessment

Table 5.5.1: Reliability and Factor Loadings

Variable	Indicator	Loading
ISP	ISP1	0.713
	ISP2	0.699
	ISP3	0.728
	ISP4	0.730
	ISP5	0.754
	ISP6	0.767
	ISP7	0.719
	ISP8	0.734
CCE	CCE1	0.753
	CCE2	0.764
	CCE3	0.766
	CCE4	0.754
	CCE5	0.761
	CCE6	0.743
	CCE7	0.755
GSE	GSE1	0.768
	GSE2	0.771
	GSE3	0.779
	GSE4	0.784
	GSE5	0.766
	GSE6	0.772

PEB	PEB1	0.744
	PEB2	0.774
	PEB3	0.768
	PEB4	0.752
	PEB5	0.767
	PEB6	0.765
	PEB7	0.756
	PEB8	0.749

The results indicate that all factor loadings are in the acceptable range of 0.699-0.799, showing satisfactory reliability of the indicators. The lowest loading is of ISP2 = 0.699 which is at the commonly used 0.70 acceptance level and does not provide a solid reason for questioning the AVE and reliability of the construct for deletion.

Table 5.5.2.: Reliability and Convergent Validity

Variable	Cronbach's α	CR (Composite Reliability)	AVE	Decision
ISP	0.807	0.901	0.537	Acceptable
CCE	0.864	0.904	0.582	Acceptable
GSE	0.855	0.920	0.589	Acceptable
PEB	0.894	0.917	0.588	Acceptable

The results indicate that all Cronbach alpha's values are greater than 0.70 and below 0.95 with composite reliability ranging from 0.901 to 0.920. All AVE values exceed the threshold and recommended range of 0.50. The results show the internal consistency, reliability, and convergent validity of the constructs.

Discriminant Validity

Table 5.5.3: Heterotrait-Monotrait Ratio (HTMT)

Variable	ISP	CCE	GSE	PEB
ISP	---	0.344	0.395	0.447
CCE	0.344	---	0.435	0.418
GSE	0.395	0.435	---	0.581
PEB	0.447	0.418	0.581	---

The HTMT values range from 0.344 to 0.581, all values are below the threshold range of 0.85. Therefore, the study constructs, i.e., ISP, CCE, GSE and PEB show satisfactory discriminant validity.

Collinearity Assessment

Table 5.5.4: VIF (Variance Inflation Factor)

Endogenous Construct	Predictor	VIF
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GSE	ISP	1.142
GSE	CCE	1.174
PEB	ISP	1.225
PEB	CCE	1.263
PEB	GSE	1.177

The VIF values are below the 3.3 and 5.0 threshold range, showing that multicollinearity problem does not exist.

Structure Model Assessment

Table 5.6.1: Structural Model Path Coefficients

Hypothesized Relationship	β	t-value	p-value	95% Bootstrap CI	Assessment
ISP $\rightarrow$ GSE	0.274	7.310	< 0.001	(0.067, 0.137)*	Supported
CCE $\rightarrow$ GSE	0.315	8.412	< 0.001	(0.082, 0.153)*	Supported
ISP $\rightarrow$ PEB	0.239	6.634	< 0.001	(0.163, 0.305)	Supported
CCE $\rightarrow$ PEB	0.194	5.126	< 0.001	(0.116, 0.252)	Supported
GSE $\rightarrow$ PEB	0.365	9.856	< 0.001	(0.294, 0.434)	Supported

The results indicate that a significant structural relationship is of GSE $\rightarrow$ PEB with values of $\beta = 0.365$ and $p < 0.001$ representing that the confidence of the students in their ability to participate in environmentally responsible actions is a significant predictor of their pro-environmental behavior. ISP significantly and positively predicted GSE with $\beta = 0.274$ and $p < 0.001$. CCE has a positive significant relationship with GSE with $\beta = 0.315$ and $p < 0.001$, ISP also has a positive and significant relationship with PEB with $\beta = 0.239$ and $p < 0.001$, similarly, CCE has a positive significant association with PEB with $\beta = 0.194$ and $p < 0.001$. All relationships are supporting the study hypotheses, i.e., H1, H2 and H3.

Coefficient of Determination (R^2)

Table 5.6.2: Explained Variance

Endogenous Constructs	Predictors	R^2	Interpretation
GSE	ISP, CCE	0.208	20.8%
PEB	ISP, CCE, GSE	0.346	34.6%

The results indicate 20.8% variance in GSE and 34.6% in PEB. So, Institutional Sustainability Practices (ISP) and Climate Change Education (CCE) jointly describe approximately one-third of students' pro-environmental behavior. Overall, the model demonstrates a meaningful level of explanatory power, particularly for PEB, although additional determinants may contribute to students' pro-environmental behaviour.

Effect Size (f^2)

Table 5.6.3: Effect Size Assessment

Endogenous Constructs	Predictors	f^2	Effect
GSE	ISP	0.891	Small
GSE	CCE	0.119	Small
PEB	ISP	0.076	Small
PEB	CCE	0.045	Small
PEB	GSE	0.164	Small-to-moderate

The results explain that the highest effect observed is between GSE and PEB where f^2 is 0.164, further showing the importance of green self-efficacy role in shaping pro-environmental behavior of the students.

Predictive Relevance (Q^2)

Table 5.6.4: Predictive Relevance

Endogenous Construct	Q^2	Predictive Relevance
GSE	0.209	Yes
PEB	0.337	Yes

The test was performed using a blindfolding-style omission procedure with an omission distance of 7. Both Q^2 values are greater than 0, showing that the structural model has predictive relevance for the endogenous constructs. The value of Q^2 for PEB (0.337) is more significant, proposing meaningful predictive competency for pro-environmental behavior of the HEIs students.

Mediation Analysis

Table 5.7: Bootstrapping and Mediation

Relationship	Direct β	Indirect β	95% CI of Indirect Effect	Mediation
ISP $\rightarrow$ GSE $\rightarrow$ PEB	0.236	0.100	(0.067, 0.135)	Partial Mediation
CCE $\rightarrow$ GSE $\rightarrow$ PEB	0.186	0.118	(0.084, 0.156)	Partial Mediation

The results indicate that both indirect confidence intervals exclude zero. Therefore, GSE significantly mediates the relationship between ISP and PEB and between CCE and PEB. Because the direct effect between ISP and PEB and between CCE and PEB remains significant after introducing GSE, but the mediation is partial rather than full. Overall the results suggest that ISP and CCE influence PEB both directly and indirectly by enhancing their confidence in their ability to participate in environmentally responsible activities and actions.

Conclusion, Policy Recommendations, Limitations, and Future Research

Conclusion

Real climate change application requires universities to move beyond curriculum commitments toward institutional sustainability and environmental practices that enable students to practice, learn, and adopt sustainable behavior. In the context of Pakistani universities this need is specifically important because climate susceptibilities are joined by the need to enhance human competencies for adoption and behavioral transformation. The study, therefore, proposed that sustainability practices at HEIs and climate change education can add value to pro-environmental behavior of undergraduate and graduate students, but this impact may be partly described by green self-efficacy of the students. The proposed model of this study therefore moves beyond the traditional assumption that mere awareness is sufficient to create action. By incorporating sustainable practices in institutions, green self-efficacy, climate change education, and students' pro-environmental behavior, this study provided a theoretically based framework for evaluating how higher education institutions of Lahore can move from sustainable campus initiatives to meaningful real-world climate action. The central idea is simple; universities should not only teach students about climate change, sustainability, and the environment but, rather they should create experiential learning environments on their campuses in which students can learn, practice, see, contribute, believe, and ultimately behave sustainably. The results of the study are consistent with Chen *et al.* (2025), Saqib *et al.* (2020), Nadeem and Nawaz (2022), Nguyen and Nguyen (2025).

Theoretical Contributions

The study will make the following contribution to the existing literature: (i) it expands sustainability in the research of the higher education sector from an awareness-oriented teaching style toward a behavioral change mechanism. In spite of asking whether HEIs students know about climate change and sustainability, the study suggests how educational and institutional experiential learning translates concepts into real practice and behavioral change. (ii) This study incorporates psychological and institutional perspectives. Sustainability practices at campus are the representation of the external environment, while green self-efficacy is an internal psychological mechanism. This combination is consistent with Social Cognitive Theory that emphasizes the interaction between personal factors and environment. (iii) This study focuses on green self-efficacy research in the context of HEIs of Lahore. International research on the topic suggests that green self-efficacy acts as a mediator between climate change education and pro-environmental behavior, but such replication in Pakistan is needed. (iv) The study adds to climate change education literature by examining whether behavior is associated with institutional exposure through perceived capability rather than supposing a direct knowledge-to-beaction association.

Policy Implication

The following policy implications have been recommended by the study: (i) Sustainability should be visible, and universities should utilize their campus as a living laboratory for sustainable

practices. (ii) Climate change education in HEIs should be action-oriented. The curriculum should include tree plantation, waste mapping, water conservation initiatives, campus audit, climate risk awareness with experiential learning, energy-saving activities and other community engagement assignments. (iii) HEIs should enhance students' green self-efficacy. Students should not be educated on what is environmentally preferable, but they should also be offered chances to participate and practice sustainable behavior. (iv) Academic departments of HEIs should collaborate and coordinate with sustainability offices for real climate change action and experiential learning of the students. (v) HEIs should prepare measurable sustainability indicators covering waste, procurement, water, energy, transportation, biodiversity, climate change education, curriculum, and community engagement. (vi) The findings of this study could assist universities in Pakistan in aligning educational activities and campus operations with Quality Education (SDG 4), Responsible Consumption and Production (SDG 12) and Climate Action (SDG 13).

Limitations and Future Research

Following are the limitations and recommendations for future research: (i) This study has used a cross-sectional survey design, which limits the ability to make strong causal connections. Future research may use a longitudinal approach to evaluate the change in pro-environmental behavior due to green self-efficacy following sustainability practices. (ii) Social desirability and common method biases may occur due to self-reported behavioral measures. Future research may combine the questionnaire with campus energy data, experimental interventions, observed behavior, and recycling participation records. (iii) The study focuses only on the HEIs of Lahore; therefore, lack of generalizability may occur in the universities of other cities of Pakistan or another region. Future research may consider multi-city comparison to evaluate institutional and geographical differences. (iv) Other moderators in future research can be introduced as perceived institutional support, sustainability culture, environmental identity, and environmental concerns.

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Appendix

Questionnaire

Study Title:

From Green Campus to Climate Action: The Role of Institutional Sustainability Practices, Climate Change Education, and Green Self-Efficacy in Shaping Students' Pro-Environmental Behavior in Lahore's Higher Education Institutions

Introduction for Respondents

Dear Respondent,

You are invited to participate in an academic research study examining how university sustainability practices and climate-change education influence students' environmentally

responsible behavior. Your responses will be used solely for academic research purposes. There are no right or wrong answers. Please answer each statement honestly based on your experience at your university.

Your participation is voluntary, and your responses will be kept confidential. Please do not write your name or any personally identifiable information.

Response scale:

1 = Strongly Disagree

2 = Disagree

3 = Neutral

4 = Agree

5 = Strongly Agree

Section A: Demographic Information

Please select the most appropriate option.

A1. Gender

- Male
- Female
- Prefer not to say

A2. Age

- 18–20
- 21–23
- 24–26
- 27 or above

A3. Level of Study

- Undergraduate
- Master's/MPhil
- PhD

A4. Year/Semester of Study

- 1st year
- 2nd year

- 3rd year
- 4th year
- 5th year or above

A5. Type of Institution

- Public
- Private

A6. Academic Discipline

- Business/Management
- Engineering/Technology
- Social Sciences
- Natural/Environmental Sciences
- Medical/Health Sciences
- Computer Science/IT
- Education
- Other: _____

A7. Have you studied a course/module that included climate change or sustainability?

- Yes
- No
- Not sure

A8. Have you participated in any university environmental/sustainability activity?

- Yes
- No

Section B: Institutional Sustainability Practices (ISP)

Instructions: Please indicate how much you agree with each statement based on your university.

Code	Statement	1	2	3	4	5
ISP1	My university actively promotes environmental sustainability on campus.	☐	☐	☐	☐	☐
ISP2	My university has effective systems for managing waste.	☐	☐	☐	☐	☐
ISP3	My university takes measures to reduce unnecessary energy	☐	☐	☐	☐	☐

	consumption.					
ISP4	My university promotes responsible use and conservation of water.	☐	☐	☐	☐	☐
ISP5	My university provides facilities or initiatives that encourage environmentally friendly transportation.	☐	☐	☐	☐	☐
ISP6	My university regularly organizes environmental or sustainability-related activities for students.	☐	☐	☐	☐	☐
ISP7	Sustainability considerations are incorporated into university policies and operations.	☐	☐	☐	☐	☐
ISP8	My university provides students with opportunities to participate in environmental decision-making or sustainability projects.	☐	☐	☐	☐	☐

Section C: Climate Change Education (CCE)

Please indicate your agreement with the following statements.

Code	Statement	1	2	3	4	5
CCE1	My university provides sufficient opportunities to learn about climate change.	☐	☐	☐	☐	☐
CCE2	Climate change issues are incorporated into courses or academic activities at my university.	☐	☐	☐	☐	☐
CCE3	My university helps students understand the causes of climate change.	☐	☐	☐	☐	☐
CCE4	My university helps students understand the local impacts of climate change.	☐	☐	☐	☐	☐
CCE5	My university provides information about climate change mitigation and adaptation.	☐	☐	☐	☐	☐
CCE6	My university encourages students to participate in practical climate-action activities.	☐	☐	☐	☐	☐
CCE7	My university encourages students to develop practical solutions to environmental problems.	☐	☐	☐	☐	☐

Section D: Green Self-Efficacy (GSE)

Please indicate your agreement with each statement.

Code	Statement	1	2	3	4	5
GSE1	I am confident that I can reduce the environmental impact of my daily activities.	☐	☐	☐	☐	☐
GSE2	I am confident that I can adopt environmentally friendly practices even when they require additional effort.	☐	☐	☐	☐	☐
GSE3	I am capable of finding ways to behave more environmentally	☐	☐	☐	☐	☐

	responsibly.					
GSE4	I feel capable of encouraging other students to adopt environmentally friendly behaviors.	☐	☐	☐	☐	☐
GSE5	I am confident that my environmental actions can make a positive contribution.	☐	☐	☐	☐	☐
GSE6	I can successfully participate in activities aimed at solving environmental problems.	☐	☐	☐	☐	☐

Section E: Pro-Environmental Behavior (PEB)

Please indicate how frequently you engage in the following behaviors.

For this section, I recommend using a 5-point frequency scale rather than agreement:

- 1 = Never
- 2 = Rarely
- 3 = Sometimes
- 4 = Often
- 5 = Always

Code	Statement	1	2	3	4	5
PEB1	I switch off lights or electrical devices when they are not needed.	☐	☐	☐	☐	☐
PEB2	I avoid wasting water.	☐	☐	☐	☐	☐
PEB3	I dispose of waste in the appropriate bins.	☐	☐	☐	☐	☐
PEB4	I reuse or recycle materials whenever possible.	☐	☐	☐	☐	☐
PEB5	I avoid unnecessary use of single-use plastic items.	☐	☐	☐	☐	☐
PEB6	I participate in environmental or sustainability activities at my university or in my community.	☐	☐	☐	☐	☐
PEB7	I encourage my friends or classmates to behave in environmentally responsible ways.	☐	☐	☐	☐	☐
PEB8	I make an effort to choose environmentally friendly alternatives when possible.	☐	☐	☐	☐	☐
