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Sustainability prioritization dynamics: how educational institutions shape student behavior through environmental values

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Sustainability has been placed at the core of higher education in India through the National Education Policy 2020. While global higher education institutions have increasingly integrated sustainability practices, developing countries such as India still face significant research and implementation gaps. The present study examines how institutional efforts shape students' sustainability values and behaviors, with a focus on the mediating role of students' understanding and efforts (SUE) and the moderating influence of home culture. With the descriptive design, a survey questionnaire grounded on theories was used to gather primary data for this investigation, collecting responses from 452 University students through Stratified random sampling from the region of Karnataka, India. Following the data collection, statistical techniques, such as measurement model and structural equation modeling, were applied to evaluate the direct and indirect impacts. As per the results, institutional sustainability policies (ISP), sustainability curriculum integration (SCI), sustainability-focused extracurricular activities (SFEC), and institutional commitment to sustainability (ICS) significantly contribute to students' environmental values (SEV), which further boost students' pro-sustainability behaviors (SPB). As per the descriptive notion, students strongly feel the responsibility to practice a sustainable lifestyle ($M = 3.99$). Moreover, SUE mediates the relationship between institutional efforts and SEV and home culture (HC) moderates the relationship between SUE & SEV. This study recommends that educational institutions design effective educational strategies for better implementation of sustainability, as it heightens social responsibility in students' behavior. Integration of sustainability in curriculum and extracurricular activities must be incorporated to expose students to achieving sustainability goals. The study is useful for developing countries because it provides a framework to deal with the specific problems that hold back these countries from implementing sustainability education. This research contributes to the achievement of the SDGs, especially SDG 4, which advocates for Quality Education, and SDG 13 on Climate Action.

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Introduction

Sustainability has emerged as one of the defining challenges of the 21 century, cutting across environmental, social, and economic domains (Sharma & Pareek, 2024). Despite rapid technological progress and global economic integration, societies continue to confront escalating ecological degradation, widening social inequalities, and fragile growth trajectories. The conceptual foundations of sustainability trace back to the Brundtland Commission's 1987 report, which articulated the imperative of meeting present needs without constraining the capacity of future generations to do the same (Greve & Laustsen, 2024). Over time, this vision has matured into a multidimensional framework that rests on three interdependent pillars: environmental integrity, social equity, and economic viability (Kaimovs & Skarupins, 2024).

Within this evolving paradigm, education is increasingly recognised as a pivotal driver for fostering sustainable development (Batista et al., 2024). Beyond equipping individuals with technical knowledge, education cultivates critical thinking, value orientation, and collective responsibility that enable societies to transition toward more sustainable practices. By embedding sustainability principles into curricula, pedagogy, and institutional cultures, education not only disseminates awareness but also mobilises innovation and action across generations. Thus, positioning education at the centre of the sustainability agenda is essential for bridging the gap between conceptual ideals and practical outcomes.

According to the 2022 Sustainable Development Report, while many countries have made progress toward the United Nations Sustainable Development Goals (SDGs), challenges remain, particularly in achieving SDG 13 on climate action and SDG 4 on quality education. For example, only 21% of universities globally report significant integration of sustainability into their curricula, highlighting a gap that needs to be addressed (UNESCO, 2023). Moreover, a study by the International Development Goal Association of Universities (IAU) in 2023 found that 68% of surveyed institutions had sustainability strategies, yet only 45% implemented these in a way that measurably impacted student behaviour. In India, the Ministry of Education Annual Report 2022 indicated that over 150 universities have incorporated sustainability elements, yet only 10% effectively monitor and report on their sustainability metrics (Ministry of Education, 2022).

By incorporating sustainability into the curriculum, through campus sustainability practices, and within communities, Higher Educational Institutions should be able to effectively instil in the minds of future generations the culture of sustainability (Cubas et al., 2024).

Although it is widely accepted that the key determinants shaping students' attitudes are the institutional practices (Ratliff et al., 2024), only a few studies have considered how the students' personal understanding of sustainability and their proactive engagement mediate the translation of institutional efforts into changes in values and behavior (Mouchrek et al., 2023). This mediation should be understood as very important for determining the real effects of the sustainability efforts made by institutions. However, the evidence of the linkage has been thin, more so in a multicultural and diverse context like India, where cultural factors are likely to play their part in moderating how students internalize institutional efforts (Singh and Chaudhary, 2022).

This study delves into the link that exists between efforts on institutional sustainability and students' sustainability values and behaviors. The study proposed a conceptual model, relating institutional efforts to sustainability practices, curricular integration, extracurricular activities, and institutional commitments toward student sustainability behaviors. This relationship is mediated by understanding and efforts of the students, where culture from their home would act as a moderator to the influence of efforts on environmental values. The following research questions guide this study:

1. How do institutional sustainability efforts influence students' sustainability values and behaviors in HEIs?
2. What role do students' understanding and proactive efforts play in shaping the connection between institutional sustainability initiatives and their behavior?
3. How does home culture influence the relationship between understanding sustainability and the internalization of sustainability values, particularly in the context of Indian HEIs?

By addressing the gap in understanding how institutional sustainability efforts shape the values, attitudes, and actions of students, this research responds to a critical need in both scholarship and practice. While sustainability has been widely theorized in environmental and economic terms, its translation into everyday behaviors through education remains underexplored. The study provides practical strategies for embedding sustainability within educational systems, thereby strengthening the role of institutions as catalysts for long-term societal change. In doing so, it not only advances academic knowledge but also generates actionable insights for policymakers and educators seeking to cultivate a generation capable of driving sustainable development.

Theoretical background of the study

Student sustainability development is a key pillar to building consciousness of the environment in institutions of learning. The transformational influence that can be applied to the pro-environmental behavior of students by the institutional leadership should be marshaling the theoretical frameworks like the Theory of Planned Behavior (TPB), Value-Belief-Norm (VBN) Theory, and Social Learning Theory (SLT). Such theories can not only help provide a substantial conceptual framework, but can also guide practical directions, through policy amendment, curricular immersion and co-curricular programming, in which sustainability can be systematically instilled into the life of the student.

The TPB states that sustainable behavior is a product of behavioral intention, which in turn is a product of the attitudes of students towards the target behavior, subjective norms and perceived behavioral control. The institutional policies to enhance a sustainable environment (e.g., mandatory recycling policies or energy-saving regulations) can also be used within this construct to have a positive impact on students and change their attitudes due to the perceived value and legitimacy of sustainable behavior (Ajzen, 1991; Dmochowski et al., 2016). Moreover, explicit institutional promise of sustainability produces normative pressure to make sustainable action socially desirable among peer groups (Abramovich and Loria, 2015; Meyer, 2016). Lastly, the growth of enabling infrastructure, such as recycling receptacles, means of public transportation, and green technologies, increases the perceived behavioral control in students, making sustainable action practical and tenable (Vallerand et al., 1992; Zsóka et al., 2013). This theory, in turn, is also directly in line with the hypothesis that institutional leadership, by means of structural and normative support, can significantly facilitate the intention and ability of students to pursue sustainable behaviors.

Parallel to it, the VBN Theory gives more psychological insight into the concept of sustainability by connecting personal values and personal norms through perceptions of the environmental conditions and perceived responsibility (Stern et al., 1999). Institutional actors are crucial in helping shape these values and

beliefs because they instil environmental ethics into both organizational policy and curricular matters. Students have either a higher likelihood of internalizing the values when sustainability is a fundamental aspect of institutional identity, and thus developing powerful moral commitments or personal habits that lead them to act in an environmentally responsible way (Schultz et al., 2005). Therefore, the VBN model guides the hypothesis that values-based leadership and policy formulation can help to put institutional sustainability commitments into the personal ethical systems of students, which results in the development of uniform sustainable behavior even in the absence of institutional control.

SLT goes hand in hand with the theory of planned behavior (TPB) and VBN by highlighting the processes involved in learning behaviors observation, modeling and social reinforcement (Bandura, 1977). Sustainability behaviors are better adopted when the students see others, mentors and institutional leaders engaging in such behaviors. Environmental service projects, campus green certifications, co-curricular programs like sustainability clubs, and other forms of experiential learning opportunities help students to put these behaviors into practice in real-life contexts (Crain, 2021; Hdeib et al., 2024). Social feedback, recognition and peer engagement also help to improve retention and re-enactment of pro-environmental behavior by reinforcement (Mcleod, 2016). Governed by this assumption, SLT supports the hypothesis that behavior change might be enhanced through the use of social influence and role modeling by participatory and socially embedded sustainability initiatives (Guerenabarrena-Cortazar et al., 2021; Steg et al., 2005).

Hence, TPB, VBN and SLT as a combination can be used to obtain a multi-level, holistic approach to student behavior in terms of outcomes, solutions and change. TPB maintains the significance of institutional structures and behavioral intention, VBN pays attention to the moralization of environmental values inside, and SLT pays attention to the importance of learning and reinforcement through social mechanisms.

Integrated review and hypothesis contraction

The leadership of institutions will foster sustainability by integrating it into policy, curriculum design and student engagement mechanisms in a systematic manner. Integrative practices influence the environmental cognitions and behavioral intentions of the students. The Theory of Planned Behavior explains the role of attitudes and perceived behavioral control in action; the VBN Theory links environmental values to moral obligation, and the SLT underlines the role of observation and modeling. Together, these conceptual frameworks provide a combination of explanatory theories of the role of institutional activities in nurturing environmental values of students and developing long-lasting, sustainable behaviour.

Sustainability policies in institutions. Sustainability efforts, when applied to higher education, are most often focused on conserving energy and recycling water. Higher education institutions gradually adopt energy-efficient technologies, such as low-consumption appliances, and thus reflect a field-wide shift to environmental effects mitigation (Figueiró and Raufflet, 2015; Thompson and Herriges, 2024). At the same time, a large number of universities pay special attention to water-conserving and recycling initiatives as conspicuous forms of environmental responsibility (Dahan and Senol, 2012). More thorough institutional approach to sustainability can be seen through policies to curb plastic use and dealing with food waste as well. In addition to the infrastructural provisions, universities inculcate principles of sustainability within the campuses through programs which engage both students and staff. Such initiatives promote long-lasting values and behaviors towards the environment when it is participated in at a deliberate and substantive level, and (Ariesanti et al., 2018; Assoratgoon and Kantabutra, 2023; Barlett and Chase, 2004). In addition, the growing interest in sustainability-related studies gives the academic responsibility and institutional authority to advance long-term ecological goals. Taken collectively, these efforts can be used to demonstrate how universities can implement sustainability, which combines multi-level approaches. Hence, it is hypothesized that

H1: Institutional sustainability policies (ISP) significantly influence the development of students' environmental values (SEV).

Sustainability in the curriculum. The inculcation of sustainability-related concepts in educational curricula ranging from pure sciences to arts and commerce management-related courses. This will make students understand that the concept of sustainability is relevant in every stream of academics. Moreover, Soares et al. (2024) reflected upon how project-based work could be taken up to overcome any problem associated with sustainability. Similarly, Howell, (2021) asserts that active learning concerning discussions, research, and team-based projects on issues regarding sustainability is very crucial to their learning. Stubbs & Cocklin, (2008) and Balbin & Balbin, (2024) have observed that these inclusions of global practices in sustainability coursework help students expand their outlook towards the subject matter and prepare them for cultural and geographical contexts. Hence, it is hypothesized that

H2: The integration of sustainability into the curriculum (SCI) has a meaningful impact on shaping students' environmental values (SEV).

Extracurricular activities for sustainability. Extra-curricular activities are an important platform where sustainability awareness is promoted, and student engagement is facilitated. Field-based projects, including campus gardening and clean-up drive offer practical learning opportunities that help students to apply theory to practice (Wheater et al., 2011). The involvement in these schemes has been linked to behavior change, such as the decline in dependence on personal cars in support of the use of various means of transport, therefore mitigating carbon emissions (Dolge et al., 2023). Student organizations like National Service Scheme (NSS), Red Cross are often involved in creating awareness programs that also bring sustainability education to the community (Hirscher, 2013) Additionally, there are innovative forms like sustainability fashion shows which spread ecological mindset, encouraging utilizing recycled and eco-friendly materials. Put together, these extracurricular activities not only increase environmental awareness but also instill the culture of sustainability both in and outside the campus environment. Hence, it is hypothesized that

H3: Participation in SFECA positively contributes to enhancing students' environmental values (SEV).

Institutional commitment to sustainability. Sustainability institutional commitment includes environmental stewardship and social responsibility. More and more universities are adopting policies that intersect waste minimization, resource minimization, and environmentally friendly technologies like biodegradable substances and solar-powered systems (Carvalho et al., 2016; Malhotra et al., 2024). These efforts are followed by socially responsible efforts- such as community outreach, recycling campaigns and tree-planting programs. Institutions also strengthen their dedication by bypassing workshops, training, and sustainability events, which are actively involved in students and,

who promote pro-environmental behavior (Thompson and Herriges, 2024). This institutional performance corresponds to the Value-Belief-Norm (VBN) Theory that explains how environmental values of biospheric, altruistic, or egoistic inclination of people influence their perception of environmental problems and form moral norms that lead to sustainable action (Negm, 2024; Stern et al., 1999). Educational programs are thus imperative in cultivating biospheric values, especially to future teachers (Yildirim and Semiz, 2019), and in forecasting responsible environmental behavior among the students, even those taking up tourism-related courses (Wang et al., 2023). Hence, it is hypothesized that

H4: Institutional commitment to sustainability (ICS) has a crucial has a positive direct effect in fostering students' environmental values (SEV).

Students' pro-sustainability behaviors. Individually, pro-sustainability behaviors among students include apparently small, but impactful behaviors, such as deactivating idle electrical devices and using reusable cloth shopping bags. As individual measures, these may seem small, but their overall impact justifies a bigger environmental goal. Zsóka et al. (2013) provide empirical evidence that shows that students regularly perform waste separation and demonstrate a preference towards products that are ecologically friendly, which proves a personal commitment to sustainability. The SLT also provides an explanation that these behaviors are developed through observation and imitation, with peers or institutional leaders being exemplars of such behaviors (Bandura, 1977; McLeod, 2016). Through this framework, Saleem et al. (2021) argue that when ethical leadership exists with institutional environmental commitment, green psychological safety climates are then created, and these climates enhance the environmentally positive behavior of students. Sustainability-based educational programs that incorporate socially responsible decision-making at the same time can promote socially responsible choices (Bashirun et al., 2023). Similarly, the research of Prates et al. (2020)) and other investigators (Moyer and Sinclair, 2020; Wong et al., 2021) stresses the idea that long-term pro-environmental behavior can be trained with the help of involving oneself in recycling and solar energy initiatives. From the above discussions, it is hypothesized that,

H5: Students' environmental values (SEV) significantly influence their pro-sustainability behaviors (SPB).

SUE toward sustainability. Students' understanding of and efforts toward sustainability are based on perceived awareness regarding sustainability issues and relevance. Research by agencies such as the EEA shows that students are increasingly aware of the damage being caused by pollution to human health and ecosystems. For example, Cogut et al. (2019) claim that students make efforts to use cloth bags and energy-efficient appliances because of an awareness of issues such as pollution and climate change. Institutional efforts that promote sustainability education empower students to go from knowledge to action and facilitate a culture of environmental stewardship (Abramovich & Loria, 2015). If students understand the consequences of environmental degradation, they will more likely support institutional policies that are sustainable (Olsson et al., 2019). This means student understanding is key because it is what we need to help institutional efforts to be reflected in students' actual 'doing' (Sidiropoulos, 2018). From this, it Hypothesized that,

H6: The relationship between Institutional Efforts (IE) and Students' Environmental Values (SEV) is significantly mediated by Students' Understanding and Efforts (SUE).

Home culture and sustainability behaviors. Home culture has the ability to mediate this by determining the degree to which the knowledge and effort of students will be converted into internalized environmental values. Although the effort of students demonstrates the impact of acquired knowledge and behavioural intention, it is possible that they are contingent on cultural reinforcement at home in forming the value. According to the Theory of Planned Behavior, it is believed that the perceived social norms, which are commonly determined by family settings, interact with self-efforts to influence behavioral outcomes (Ajzen, 1991; Effendi et al., 2020). Research has established that environmental behaviors become even more likely to become lasting values when they are reinforced by familial practices and norms (Correia et al., 2022; Omer, 2011; Pereira et al., 2022). Besides, institution's sustainability values that are internalized through home environments with an ecological focus can reinforce (Frisk and Larson, 2011; Payne, 2005). Thus, home culture does not simply directly predict behavior, but alters the strength of the correlation between the efforts of students and environmental values, in particular, through strengthening or undermining the perceived applicability of sustainability to everyday life (Ünal et al., 2018; Vicente-Molina et al., 2013). By this, it is hypothesized that,

H7: Home Culture (HC) serves as a moderator in the relationship between Students' Understanding and Efforts (SUE) and their Environmental Values (SEV).

Although the sustainability initiatives in higher education have a well-documented history in the developed world, especially in the US, little is known about how practices and programs in institutions can affect the student values and behaviors in a developing nation situation. In addition, little research has investigated the effects of cultural and individual-level variables, including home culture, that moderate these relationships. This research fills this gap by synthesizing the institutional, behavioral and cultural lenses to explore the context in which sustainability practices in schools influence the environmental values of their students. The study extends the existing uses of the Theory of Planned Behavior by introducing the moderating variable of home culture and offers a culturally specific framework of understanding sustainability education in developing areas. From the literature and theory, the following conceptual model developed and shown in the Fig. 1.

Methodology

Research design. A quantitative approach is used to maintain objectivity and achieve statistical accuracy during data collection. A structured questionnaire is created to capture measurable data, facilitating the identification of patterns and relationships. The data is then rigorously analyzed and interpreted using statistical methods to extract meaningful insights.

Instrument development. Since there is no standard measurement tool in the published literature to evaluate the impact of institutional efforts on the values and behaviors of the students with the mediating effect of student understanding and efforts towards sustainability and the moderating effect of home culture environment, the researcher developed a questionnaire through a systematic and scientific procedure and also tested the same as per well-accepted reliability and validity procedure.

Item generations. With the help of previous literature and focus group studies, the researcher constructed items to measure predetermined constructs such as institutional efforts, student understanding and efforts towards sustainability, home culture environment of the students towards sustainability and students'

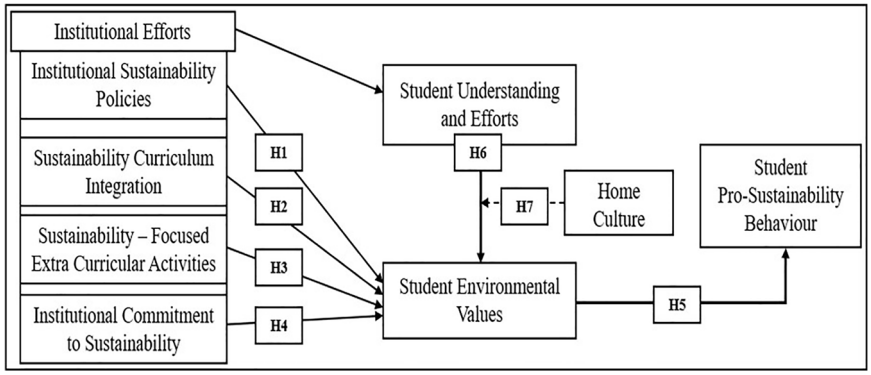

Fig. 1 Conceptual model. Developed by the author.

pro-sustainability behaviours from the institution's administrators, sustainability coordinators, faculty, NGOs, operations and facility managers.

A focused group discussion was conducted among the institution's administrators, sustainability coordinators, faculty, NGOs, operations and facility managers; each group consisted of six experts. Open-ended questions were raised, which are 'What are the various methods in which the institution puts in effort to help students accept and follow sustainability practices?' 'Does the sustainability practices of the students at home build students practice in institutions?' and 'Does students understanding and efforts towards sustainability impact institutional efforts in building sustainability values and behaviors?' The opinions of experts from the focus group study were recorded, and later, content analysis was performed to generate specific items for constructs. In the first stage, the researcher identified 16 items for ISP, 11 items for SCI, 9 items for SFEC, 12 items for ICS, 13 items for SUE, 13 items for HC, 8 items for SEV and 10 items for SPB. In the second stage after considering the opinion of experts 8 items for ISP measured using (Birdman et al., 2022; Kong et al., 2023), 5 items for ICS measured using Dahan & Senol, (2012; Henningsson et al. (2004), six items for SCI measured using Birdman et al., (2022); Epstein, (2018); Watson et al. (2013); Žalėnienė & Pereira, (2021),6 items for SFEC measured using Adam, (2021); Assoratgoon & Kantabutra, (2023); Cervellon & Wernerfelt, (2012), 8 items for SUE measured using Paritosh Kasotia, (2020), 11 items for HC measured using Çetiner & Yenilmez, (2021), 5 items for SEV measured using Mititsina et al. (2021) and 9 items for SPB measured using Janmaimool & Khajohnmanee, (2019); Kollmuss & Agyeman, (2002).

Response structure. The questionnaire is divided into six parts, the first part concerns to demographic profile of the respondents through the closed-ended questions. From the second part to the sixth part is related to institutional efforts on the students' values mediated by students' understanding and efforts towards sustainability and moderated by the home culture of the students sustainability, which leads to students pro-sustainability, and questions were asked on the five-point Likert scale, where 5 (Strongly Agree) and 1 (Strongly Disagree).

Sources of data. The participants in this study were graduate and postgraduate students from different universities in Karnataka, India, including affiliated colleges, private universities, international universities, central universities, and deemed universities. The selection process aimed to have a varied mix of students at different education levels within the state. A pilot study was carried out initially to test the study's tools on both graduate and postgraduate students to ensure accurate and valid results. The preliminary findings from this pilot study gave us important insights and confirmed that our research approach is feasible. The data primarily relied on survey, where many authors (Hider and Pymm, 2008) suggest the perception survey method in stakeholder studies, as a result, the present research gathered primary data through an online survey form between the time period of 4 months, i.e., from May to August 2024. The Google form was circulated among the students by personally visiting the classrooms with the permission of management during class hours. These students are the most suitable population for the current research as they provide their opinions about institutional efforts.

Population and sample. After the initial study, we gathered data from a group of 452 participants. As per NAAC, including all types of higher education (National Assessment and Accreditation Council, 2019), i.e., Affiliated Colleges, Autonomous Colleges, Private Universities, Deemed Universities, State Universities, Central Universities, and Institute of National Importance, over 58,000 educational institutions are situated in India with a large student population of 43.3 million. In this regard, Karnataka is a large educational hub, with over 4.92 million students registered, making it an excellent representation of higher education in India. The state has been a pioneer in sustainability measures, harmonising with national and global objectives such as the SDGs and NEP 2020. Its institutions regularly implement sustainability initiatives, providing an ideal setting for researching their influence on student values. Finally, Karnataka's excellent research collaboration and data availability make the study more feasible and relevant. According to AISHE (All India Survey on Higher Education) 2020–21 data (Ministry of Education, 2022), Karnataka has ~4,928,000 students enrolled in higher education across all types of institutions. The sample was calculated using the formula suitable for finite populations, after which the sample size resulted in 384 responses. In order to avoid incomplete responses, the questionnaire was circulated to more than 384 respondents, on average, to 500 respondents. As a whole researcher in this study collected 452 responses. By including students from various academic levels and different educational institutions in Karnataka, our goal was to obtain a thorough understanding of sustainability awareness and its impact on sustainable practices among graduate and postgraduate students in the region, using Stratified random sampling, proportional allocation, and with inclusion/exclusion criteria.

Sample profile. Out of the collected responses, 452 respondents accurately filled out the Google form, which was considered for further analysis. Table 2 describes the sample profile, which demonstrates the sample distribution based on gender, residual area, type of residence, occupation of the parents/guardian,

Table 1 Sample profile.

Variable	Categories	Frequency	Percentage
Gender	Male	331	73.2
	Female	121	26.8
Residual area	Rural	159	35.2
	Urban	181	40.0
	Semi-Urban	112	24.8
Type of residence	House	369	81.6
	Apartment	66	14.6
	Dormitory	17	3.8
Occupation of the parents/guardian	Salaried	178	39.4
	Daily wages	48	10.6
	Business Income	174	38.5
	Agricultural Income	40	8.8
	Other Sources	12	2.7
Number of Members in the Family	Less than 3	39	8.6
	4-6 members	362	80.1
	More than 6	51	11.3
Family annual income	Below Rs. 1 lakh	243	53.8
	Rs. 2 lakhs - Rs. 5 lakhs	144	31.9
	Rs. 6 lakhs-Rs. 10 lakhs	45	10.0
	More than Rs. 10 lakhs	20	4.4
Personal vehicle	Yes	238	52.7
	No	214	47.3
Daily mode of transportation	Public bus	300	66.4
	Bike/Car	105	23.2
	Train	20	4.4
	Taxi/Rickshaw	3	0.7
	Walking	24	5.3
Type of Institute	Central University	7	1.5
	State University	4	0.9
	Deemed to be University	422	93.4
	Affiliated to University	4	0.9
	Private University	9	2.0
	Autonomous Colleges	6	1.3
NAAC grade is accredited to institution	A++	90	19.9
	A+	322	71.2
	A	29	6.4
	B++	2	0.4
	B+	2	0.4
	B	5	1.1
	C	1	0.2
	D (not accredited)	1	0.2

Source: primary survey.

number of members in family, family annual income, personal vehicle, daily mode of transportation, type of institute and NAAC grade accredited to their institution. The percentage analysis exhibits that the majority, 331 (73.2%) of the respondents are Male, and the remaining 121 (26.8%) respondents are Female. Most of the respondents, 181 (40%), stay in Urban areas, and 159 (35.2%) stay in rural areas. The largest group of respondents 369 (81.6%) stay at their house, other stay at Apartment 66 (14.6%), and Dormitory ~17 (3.8%) also make up significant portions of the group. Most of respondents 178 (39.4%) are salaried, 174 (38.5%) of them have Business Income and 48 (10.6%) respondents get daily wage. In the case of the number of members in a family, 362 (80.1%) of respondents have 4–6 members, 51 (11.3%) have More than 6 and 39 (8.6%) of them have fewer than 3 members in their family. 243 (53.8%) of the respondents have an annual income below Rs. 1 lakh, and 144 (31.9%) of them earn Rs. 2 lakhs–Rs. 5 lakhs, and the remaining earn above Rs. 6 lakhs annually. 238 (52.7%) of respondents have their own vehicle, and 300 (66.4%) of the respondents prefer Public bus as a Daily mode of Transportation, 105 (23.2%), and 24 (5.3%) of them prefer walking. 422 (71.2%) of respondents are deemed to be university students, and 322 (71.2%) students belong to the institution, which is accredited as A+.

Exploratory factor analysis. Exploratory Factor Analysis was used as a dimension reduction technique to determine each item's factor loading. This allows the researcher to decide whether to retain or remove a particular item for further analysis (Cureton and D'Agostino, 2013; Fabrigar and Wegener, 2011). Therefore, the researcher conducted EFA, and the result is tabulated in Table 1. The minimum factor loading criteria was set to 0.50 (Leech and Onwuegbuzie, 2009). Since the factor loading of each item is >0.5, all items under each factor significantly represent the respective constructs. Further, the Kaiser–Meyer–Olkin (1974) Measure of Sampling Adequacy showed 0.828 (accepted level >0.7), and Bartlett's test of Sphericity (1950) showed p value lesser than 0.001. This indicates that the correlation matrix is statistically significant.

Extraction, rotation, and retention. As correlations among constructs were theoretically expected, we conducted principal axis factoring (PAF) with Promax ($\kappa = 4$) oblique rotation on the full sample ($N = 452$). Factor retention was based on theory, the scree plot, eigenvalues greater than 1, and a parallel analysis logic. An eight-factor solution was retained, corresponding to ISP, SCI, SFEC, ICS, SUE, HC, SEV, and SPB. Items were retained if their primary pattern loading ≥0.50, all cross-loadings <0.30, and loading gap ≥0.20 (primary minus largest cross-loading). No retained item showed cross-loading ≥0.30. The eight extracted factors collectively explained 64.81% of the total variance, with individual factor contributions ranging from 4.42% to 12.02% after rotation, indicating a well-balanced factor structure and clear construct differentiation.

Construct validity. In order to confirm the validity and reliability of the constructs and their dimensions, the measurement model needs to satisfy Hair et al. (2010)'s recommendations. The measurement model assessment found the factor loadings above the threshold of 0.60, all included indicators were deemed intact and not subject to removal (Table 2). The results depicted a favorable index of goodness of fit as recommended by Hair et al. (1998; 2010), Hu and Bentler (1999), and Byrne (2001, 2013) (SRMR = 0.071; GFI = 0.915; AGFI = 0.916; CFI = 0.912; NFI = 0.912; RMSEA = 0.051). Within the context of a research paper, the construct validity test constitutes a pivotal methodology aimed at evaluating the extent to which a measurement instrument effectively aligns with the underlying theoretical construct it is designed to assess (Sireci, 1998; Strauss and Smith, 2009). This validation process plays an instrumental role in corroborating the congruence between the data gathered and the stipulated research objectives, thereby bolstering the research's overall veracity and dependability (Segars and Grover, 1998). Specifically, within the domain of construct validity, two distinct facets are commonly examined: convergent validity and discriminant validity. The reliability of the variables was assessed using composite reliability (CR). Since the factor loading of each item is >0.5 with all retained items meeting the ≥0.50 threshold, most exceeded 0.60 (lowest retained loading = 0.537). Internal consistency at the EFA stage was assessed using Cronbach's α for

Table 2 Factor loadings, reliability and convergent validity results.

Item	Statements	EFA	Measurement model	Mean	S.D.	α	CR	AVE
ISP5	Our institution has energy-saving procedures and equipment's	0.801	0.797	3.7367	0.91024	0.902	0.899	0.529
ISP4	Water recycling is promoted on our campus.	0.791	0.782	3.7080	0.92208			
ISP2	Our institute has restrictions on the usage of plastics and food waste on the campus.	0.790	0.782	3.6549	1.00350			
ISP3	Our institution organizes sustainability-related programs for students, teachers and non-teaching staff.	0.759	0.757	3.8783	0.87375			
ISP6	Our institution encourages research projects related to sustainability.	0.754	0.752	3.8164	0.86026			
ISP8	Purchasing goods that are environmentally friendly is the top priority in our institute.	0.695	0.695	3.6681	0.91091			
ISP1	Our institution has a committee to look into all the sustainability efforts.	0.687	0.682	3.7942	0.89822			
ISP7	Our institution has a tie-up with local communities on sustainability practices.	0.537	0.534	3.7500	0.92123			
SCI4	Sustainability concepts are integrated in various academic programs like Science, Arts, Commerce and Management.	0.791	0.789	3.9535	0.78232	0.884	0.878	0.547
SCI6	Our college engages in project-based learning, which helps to overcome sustainability challenges	0.789	0.785	3.8540	0.77139			
SCI3	I think the existing curriculum (syllabus, assignments and other learning resources) successfully incorporates sustainability concepts.	0.768	0.764	3.7788	0.82084			
SCI5	We engage in active learning related to sustainability in our coursework, such as lectures, discussions, research, etc.	0.741	0.732	3.7987	0.80282			
SCI2	Our coursework exposes the global sustainability practices and measures.	0.715	0.705	3.7854	0.79380			
SCI1	Sustainability education encourages personal interest and future career goals (policy making, sustainable business, etc)	0.674	0.653	3.8451	0.75511			
SFEC3	We engage in various outdoor sustainability activities like gardening, campaigns, etc.	0.769	0.762	3.7301	0.91921	0.876	0.870	0.528
SFEC2	We are involved in various environmental clean-up events, such as parks, beaches, flood-affected areas, etc.	0.752	0.746	3.7942	0.82352			
SFEC5	We use public transport instead of private vehicles to reduce carbon emissions.	0.749	0.745	3.6593	0.89285			
SFEC1	We bring awareness in society by organizing programs with units like the NSS and the Red Cross.	0.732	0.716	3.9270	.80820			
SFEC4	We plant trees and bring awareness to people about nature towards sustainability	0.721	0.712	3.8319	0.81453			
SFEC6	We host sustainability fashion shows made with eco-friendly products like clothes, recycled products, etc.	0.685	0.675	3.6836	0.90546			
ICS3	Institution looks for methods to cut down the waste and encourage the use of resources effectively.	0.832	0.813	3.8075	0.82405	0.892	0.882	0.600
ICS2	Our institution promotes eco-friendly activities like the less use of plastics, the use of solar panels, the use of biodegradable products, etc.	0.822	0.802	3.6925	0.79947			
ICS1	Our institution provides various incentives to promote alternative modes of transportation, like bus passes, van facilities, etc.	0.791	0.768	3.7788	0.83954			
ICS4	Our institution is involved in various CSR activities like cleaning, planting trees, recycling programs, etc.	0.759	0.750	3.7522	0.81864			
ICS5	Our college organizes workshops, sessions and training programs on sustainability.	0.741	0.737	3.7633	0.85756			
SUE4	Pollutions harm human health and the ecosystem	0.761	0.754	3.9712	0.81915	0.896	0.890	0.503
SUE3	A drought can worsen the condition of agricultural productivity	0.752	0.741	3.8451	0.82795			
SUE2	Climate change can drastically alter rainfall patterns and risk water and food supplies for millions.	0.744	0.734	3.8805	0.80677			

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Table 2 (continued)

Item	Statements	EFA	Measurement model	Mean	S.D.	α	CR	AVE
SUE5	I am concerned about making pure water available for future generations	0.739	0.731	3.9491	0.82078			
SUE1	I think that when one plant is cut down, another plant should be planted.	0.702	0.690	3.9801	0.80577			
SUE7	I turn off the electricity when not in use	0.691	0.684	3.9690	0.83648			
SUE8	Carry a cloth bag while shopping	0.687	0.668	3.8319	0.84394			
SUE6	Use energy-efficient appliances at home	0.673	0.663	3.8850	0.82373			
HC1	Measured using the type of income and the family's annual income	0.778	0.767	3.9934	0.76070	0.935	0.914	0.559
HC2	My friends and family influence me to practice sustainability	0.769	0.760	3.8894	0.77727			
HC3	We have air-purifying plants at home	0.747	0.759	3.8119	0.88473			
HC4	Festivals and marriages are celebrated in an environmentally friendly nature	0.741	0.739	3.8606	0.78543			
HC5	Since childhood, I have been taught to protect the environment in my community	0.735	0.730	3.9580	0.76248			
HC7	Knowledge of digitalization is promoted in my locality	0.723	0.718	3.8606	0.73587			
HC11	Access to health services in my locality is convenient	0.723	0.708	3.9314	0.78916			
HC6	I am able to afford natural soap. Shampoo & cosmetic products	0.713	0.705	3.8650	0.81663			
HC10	I am financially capable of installing solar devices in my house	0.701	0.697	3.7367	0.86014			
HC8	Pure drinking water and organic food are available in my locality	0.655	0.655	3.9757	0.77764			
HC9	A public transportation facility is available at my place	0.632	0.632	3.9447	0.82588			
SEV4	Institutional sustainability policies have played a role in using electricity efficiently and saving it	0.774	0.760	3.9469	0.77763	0.857	0.847	0.526
SEV3	Institutional sustainability commitments influenced me to use eco-friendly products	0.754	0.738	3.8761	0.71267			
SEV1	Every individual is responsible for undertaking initiatives to keep the environment clean	0.738	0.736	3.8827	0.77486			
SEV2	Project-based learning has given insights into overcoming environmental issues	0.736	0.714	3.8407	0.77163			
SEV5	After being involved in environmental activities, I realized the importance of keeping the environment clean and tidy	0.689	0.675	3.8982	0.72845			
SPB7	I feel the responsibility to practice a sustainable lifestyle	0.864	0.875	3.9934	0.76361	0.954	0.953	0.693
SPB1	I segregate waste before disposing of it	0.874	0.864	3.8186	0.74917			
SPB8	I use only environmentally friendly products and services	0.849	0.837	3.7854	0.83199			
SPB2	I deny receiving a plastic bag when purchasing a few grocery items	0.840	0.837	3.8075	0.88628			
SPB9	LED lights are used at my home to save electricity	0.838	0.836	3.9049	0.78921			
SPB4	I use a cloth handkerchief instead of a paper towel	0.823	0.822	3.8319	0.82266			
SPB5	I prefer eating at restaurants to takeaways	0.820	0.820	3.8562	0.80692			
SPB6	I fix the tap immediately when I see water leakage	0.816	0.814	3.9513	0.76354			
SPB3	I take part in Swachh Bharat Abhiyan	0.792	0.783	3.8230	0.83419			

Source: Computed using SPSS.

Table 3 Discriminant validity using the criterion by Fornell & Larcker.

	ISP	SCI	SFECA	ICS	SUE	HC	SEV	SPB
ISP	**0.727**							
SCI	0.620	**0.739**						
SFECA	0.691	0.624	**0.727**					
ICS	0.722	0.618	0.725	**0.775**				
SUE	0.662	0.706	0.686	0.593	**0.709**			
HC	0.698	0.569	0.714	0.565	0.518	**0.748**		
SEV	0.513	0.718	0.643	0.698	0.706	0.669	**0.725**	
SPB	0.717	0.714	0.721	0.585	0.685	0.695	0.501	**0.833**

ISP institutional sustainability policies, *ICS* institutional commitment to sustainability, *SEV* students environmental values, *SFECA* sustainability-focused extra-curricular activities, *SCI* sustainability curriculum integration, *SPB* students pro-sustainability behaviors. Source: computed using SPSS & AMOS.

each construct, ranging from 0.857 to 0.954. For continuity with the CFA, CR, and average variance extracted (AVE) are also reported in Table 2. The results of reliability and validity for all the items are depicted in Table 2 CR values for all the variables were greater than the recommended value of 0.700. The AVE values and CR values were higher or close to 0.500 and 0.700, respectively, which confirms convergent validity (Carlson et al., 2009; Shrestha, 2021).

Discriminant validity. Discriminant validity is a critical aspect of construct validity, ensuring that a measurement instrument can effectively differentiate between different constructs (Henseler et al., 2015). Two widely accepted methods for assessing discriminant validity are the Fornell and Larcker criterion and HTMT, which examines the relationships between constructs and their AVE. Here we implemented Fornell and Larcker, where the value of AVE is all more than the threshold value of 0.50 (Fornell and Larcker, 1981). Maximum Shared Variance values are all lower than the AVE values, supporting discriminant validity. The association between constructs is denoted with triple asterisks, indicating statistical significance. These significant inter-construct correlations, while moderate to high, are below the square roots of the AVEs, further confirming discriminant validity (Fornell and Larcker, 1981). This thorough evaluation indicates that the constructs are both reliable and valid for measuring their respective domains. Table 3 shows that the diagonal values, which are greater than the correlation between the constructs, indicate that discriminant validity is not an issue.

Tools. To achieve the study's objectives, descriptive statistics (mean and standard deviation) were used to assess the impact of institutional sustainability efforts on students' understanding, values, and pro-sustainability behavior. Structural equation modeling (SEM) was applied to analyze how SUE influence the connection between institutional initiatives and their values, and how institutional efforts impact pro-sustainability behavior, considering the influence of home culture. SEM also evaluated the validity, reliability, and goodness of fit of the proposed conceptual model (Barrett, 2007). This tool, implemented using IBM SPSS AMOS 2022, is essential for examining complex relationships across various domains, including psychology, education, and business.

Results

This section is divided into two parts the first section reveals descriptive results on the perception of students towards institutional efforts towards sustainability, how it impacts their understanding and efforts, their environmental values and behaviors towards sustainability. The role of home culture practices of sustainability towards students values and behaviors is also considered. In the second section results of the structured equation model, mediation and moderation analysis are provided.

Descriptive statistics. Table 2 shows the results of the perception of the students towards the institutional efforts towards sustainability, which is measured using institutional sustainability policies, sustainability curriculum integration, sustainability focused extra-curricular activities and institutional commitment to sustainability.

Institutional sustainability policies. Measuring institutional sustainability efforts helps assess their impact on students' attitudes and behaviors, identifying opportunities to promote a sustainability culture. Student perceptions serve as valuable input for this research, with strong support for restrictions on plastics ($M = 3.8783$) and eco-friendly purchasing ($M = 3.8164$). Overall, institutional policies are positively recognized (mean $= 3.751 \pm 0.913$).

Sustainability curriculum integration. This section presents a descriptive analysis of students' agreement on sustainability curriculum integration. Table 2 shows six items measuring this integration, with the highest mean score ($M = 3.9535$) for "active learning related to sustainability." Students also agreed that sustainability education aligns with career goals ($M = 3.8540$). Overall, the positive response (mean $= 3.85 \pm 0.79$) indicates effective curriculum integration, though some improvement is possible.

Sustainability–focused extra-curricular activities. Table 2 highlights the institution's efforts to integrate sustainability into extracurricular activities, measured by six items. The highest mean ($M = 3.9270$) was for engaging in outdoor activities like gardening, showing high student value for hands-on initiatives. Organized programs with units like NSS also received strong support ($M = 3.8319$). Overall, students positively perceive these efforts ($M = 3.7709 \pm 0.8603$), valuing practical and awareness-driven activities.

Institutional commitment to sustainability (ICS). Table 2 highlights the institution's commitment to sustainability, assessed through five items. The highest mean ($M = 3.8075$) for incentives for alternative transportation indicates strong student appreciation in this area. Effective resource use also ranked highly ($M = 3.7788$), while promoting eco-friendly activities had the lowest mean ($M = 3.6925$), suggesting room for improvement. Overall, students positively view these initiatives ($M = 3.759 \pm 0.8271$).

Students' understanding and efforts towards sustainability. Understanding and promoting sustainability among students is crucial as it equips them to become future leaders capable of addressing global environmental challenges (Sterling, 2011) and ensures long-term planetary health by conserving resources. It enhances social responsibility, encouraging participation in community-based initiatives (Barth et al., 2007), and aligns with global goals like the UN's SDGs, driving innovation in sustainable solutions (UNESCO, 2017; Wiek et al., 2011).

Table 2 reflects SUE towards sustainability, shaped by institutional initiatives. The highest mean ($M = 3.9801$) was for "Pollution harms health and the ecosystem," showing strong student awareness. Concern for water conservation ($M = 3.9712$) also ranked high. However, energy efficiency at home had a lower mean ($M = 3.8319$), suggesting less emphasis. Overall, students prioritize pollution impact and water conservation ($M = 3.914 \pm 0.823$), indicating effective institutional efforts, though home energy efficiency may need more focus.

Home culture towards sustainability (HCS). Table 2 highlights the influence of home culture on students' sustainability awareness. The highest mean ($M = 3.99$) was for "Measured using type of income and family annual income," indicating the value placed on economic stability. Access to pure water and organic food also ranked high ($M = 3.98$). However, lower financial capability for installing solar devices ($M = 3.74$) suggests cost-related barriers. The overall mean ($M = 3.893 \pm 0.798$) underscores the significant role of the home environment, though economic factors limit further sustainable practices.

Students environmental values (SEV). Table 2 illustrates the role of students' environmental values in their sustainability commitment. The highest mean ($M = 3.95$) was for "Institutional sustainability policies promoting energy efficiency," reflecting strong student appreciation. Active participation in environmental activities also scored high ($M = 3.90$), enhancing commitment. However, project-based learning had a lower influence ($M = 3.84$). The overall mean ($M = 3.889 \pm 0.753$) suggests that institutional policies and hands-on activities effectively shape environmental values, while academic projects may have a lesser impact.

Students pro-sustainability behaviors (SPB). Table 2 highlights students' pro-sustainability behaviors, reflecting a strong sense of environmental responsibility. The highest mean ($M = 3.99$) was for "I feel responsible for practicing a sustainable lifestyle," emphasizing personal accountability. Preventing water wastage also ranked high ($M = 3.95$). However, consistent use of eco-friendly products scored lower ($M = 3.79$), suggesting challenges. The overall mean ($M = 3.864 \pm 0.805$) indicates that students prioritize practical actions but may face barriers to fully adopting sustainable products.

Structural equation model. The next phase of our analysis involved evaluating the proposed connections. Table 4 reveals the direct relationship between the variables used in the conceptual model.

Table 4 demonstrates the direct effect of Institutional Efforts on students' environmental values, and its impact on students' pro-sustainability behaviors. About H1 it is found that there is a positive relationship between ISB and SEV, with a beta coefficient of 0.266, which is statistically significant with a t value of 2.760 and a p value of 0.000. Concerning H2, it is observed that there is a positive relationship between SCI and SEV with a beta coefficient of 0.128. This relationship is also statistically significant with a t value of 3.834 and a p value of 0.000. Hypotheses H3 also bear significant results stressing the positive association between SFECA and SEV with a beta coefficient of 0.252, which is statistically significant with a t value of 4.916 and a p value of 0.000. Concerning hypothesis H4, it is observed that there is a positive relationship between ICS and SEV with a beta coefficient of 0.361, which is statistically significant with a t-value of 8.444 and a p value of 0.000. Hypothesis H5 is also supported with a positive relationship between SEV and SPB with a beta coefficient of 0.737, which is statistically significant with a t-value of 16.487 and a p value of 0.000. In a nutshell, the above results emphasize the significant direct relationships among the variables employed in the conceptual model. Therefore, the study accepts all hypotheses (H1 to H5) at a 5% significance level.

Mediation analysis (H6). This section of analysis part of the study focuses on mediation analysis, which is indicated in Table 5 and Fig. 2.

The mediation analysis examined whether SUE mediates the relationship between institutional efforts (IE) and SEV. The results (Table 5) show that the total effect of institutional efforts on environmental values was positive and significant ($\beta = 0.735$, $p < 0.001$). Importantly, both the direct effect of institutional efforts on environmental values ($\beta = 0.300$, $p < 0.001$) and the indirect effect through SUE ($\beta = 0.435$, $p < 0.001$) were significant. This pattern demonstrates partial mediation, indicating that while SUEs serve as a meaningful pathway linking institutional initiatives to environmental values, institutional efforts also retain a direct influence independent of the mediator. These results highlight that sustainability programs in higher education are most effective when

Table 4 Direct effect of Institutional Efforts on students' environmental values, and its impact on students' pro-sustainability behaviors.

Hypothesis	Path	Beta	t value	P	Remark
H1	ISP→SEV	0.266	2.760	0.000	Supported
H2	SCI→SEV	0.128	3.834	.000	Supported
H3	SFECA → SEV	0.252	4.916	.000	Supported
H4	ICS →SEV	0.361	8.444	.000	Supported
H5	SEV→SPB	0.737	*16.487*	.000	Supported

Source: output of primary data using AMOS.
ISP institutional sustainability policies, *ICS* institutional commitment to sustainability, *SEV* students environmental values, *SFECA* sustainability-focused extra-curricular activities, *SCI* sustainability curriculum integration, *SPB* students pro-sustainability Behaviors.

Table 5 Mediating role of students understanding and efforts (sustainability) between institutional efforts (sustainability) and students environmental values (sustainability).

Path	Total effect	Direct effect	Path	Indirect effect	P value	Remarks
IE→SEV	0.735	0.300	IE→SUE→SEV	0435	0.000	Supported

Source: output of primary data using AMOS.
IE institutional efforts, *SEV* students' environmental values, *SUE* students understanding and efforts.

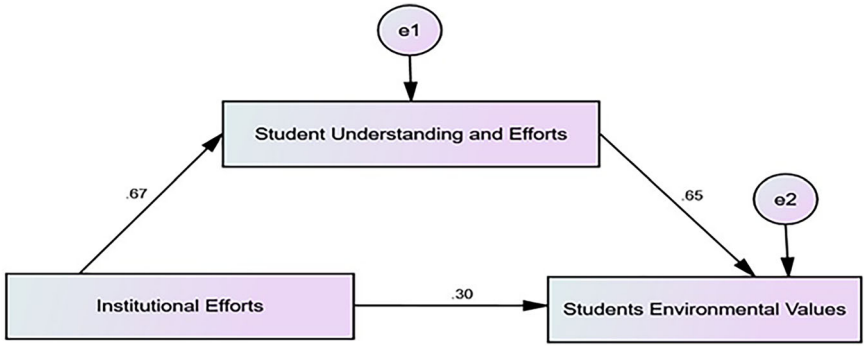

Fig. 2 Mediation model of institutional efforts and students' environmental values. The figure illustrates the mediating role of student understanding and efforts in the relationship between institutional efforts and students' environmental values. Standardized path coefficients are shown along the arrows.

Table 6 Moderation analysis of home culture (sustainability) between students' understanding and efforts (sustainability) & students' environment values (sustainability).

Moderation variable	Path	Beta	S.E.	*t* value	*P* value	Remarks
Home	SUV→SEV	0.572	0.046	12.435	***	Significant
Culture	HC→SEV	0.342	0.039	8.769	***	Significant
	Intercept→SEV	0.264	0.0414	6.377	***	Significant

Source: output of primary data using AMOS.

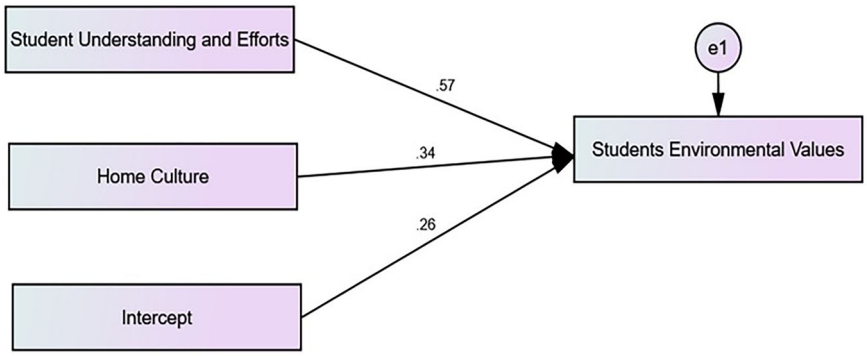

Fig. 3 Moderation effect. Output of survey data using AMOS.

they combine institutional initiatives with mechanisms that actively engage and empower students. Thus, H6 is accepted.

Moderation analysis (H7). In this section, the effect of the HC of the students towards sustainability on students' understanding and efforts and students' environmental values is focused.

The Table 6 and Fig. 3 assesses the moderating position of HC (that is, social-economic status, cultural background and access to sustainability resources) between students understanding and efforts and students environmental values towards sustainability. The path coefficient between the path students understanding and efforts and students environmental values towards sustainability with beta value obtained of 0.512, which indicates a positive direct relationship between the students understanding and efforts and students environmental values towards sustainability. Meanwhile, HC was moderated on this relationship with a beta value of 0.342, for which the calculated t-statistic is equal to 8.769 consequently, the *p* value obtained is 0.000, suggests that there is a moderate effect of HC on the moderator's scale implying that there is a strong positive correlation between HC and the students understanding and efforts on one hand, and students environmental values on the other. Followed by, Intercept (beta = 0.264, $p = 0.000$) indicates a baseline effect on the students environmental values that is independent of the main variables and their interaction. This paper suggests that HC of the students plays an important role in students environmental values and their attitude towards sustainability. As the effect of students understanding and efforts toward students environmental values is highly conditioned by HC, it's necessary for institutions to encourage parents to practice sustainability at home.

The above Fig. 4 also signifies that when the home culture towards sustainability is low, it results in low student understanding and efforts towards students' environmental values. Whereas a high home culture strengthens the students' understanding and efforts towards students' environmental values. It suggests that institutions should conduct programs to educate the family members to practice sustainability at home so that students' values towards sustainability are enhanced. So, the hypothesis (H7) is supported.

Figure 4 further clarifies the conditional relationship between SUE and their environmental values (SEV). Specifically, the slope of the relationship differs depending on students' HC. When home culture strongly supports sustainable practices (e.g., families that conserve energy, use eco-friendly products, or

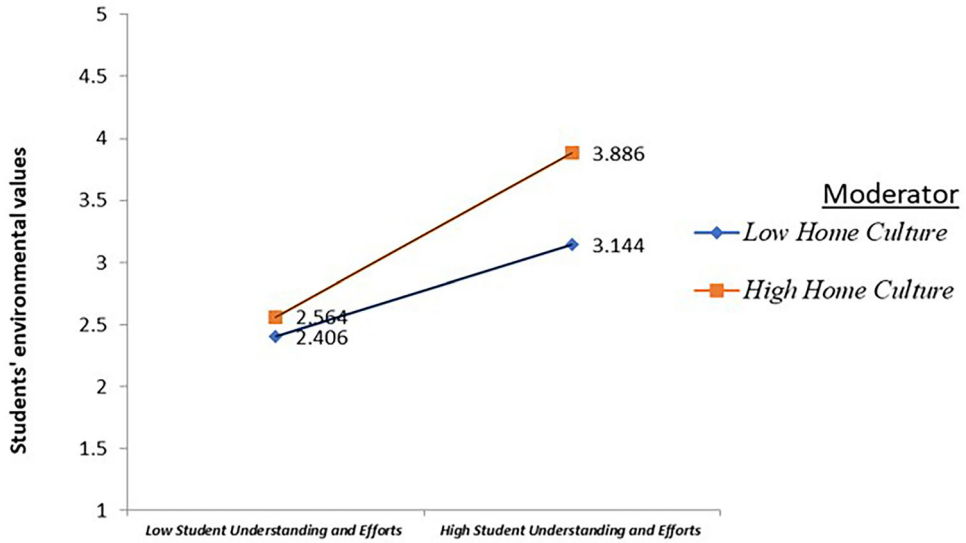

Fig. 4 Moderating role home culture between institutional efforts and students' environmental values. Output of primary data using AMOS.

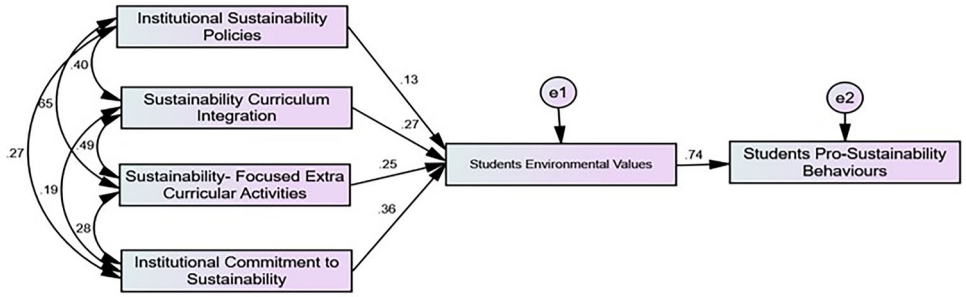

Fig. 5 Path analysis. Output of primary data using AMOS.

encourage recycling), the positive association between SUE and SEV is significantly stronger. Conversely, when home culture provides little reinforcement, the same level of student understanding translates into weaker environmental values. This finding supports the hypothesized moderation effect and highlights the importance of aligning institutional initiatives with family-level practices to maximize their impact.

Path analysis. After assessing the measurement model, SEM was implemented to test the proposed hypotheses, as the reliability and validity were fulfilled. The implementation of SEM requires the fulfilment of certain assumptions, i.e., testing its goodness of fit that compares how well the theoretical model fits the estimated model. The results depicted a favorable index of goodness of fit as recommended by Hair et al. (1998; 2010), Hu and Bentler (1999), and Byrne (2001, 2013) (SRMR = 0.078; GFI = 0.922; AGFI = 0.901; CFI = 0.931; NFI = 0.921; RMSEA = 0.054).

The path analysis model (See Fig. 5) illustrates how institutional sustainability policies, curriculum integration (0.65), SFEC (0.49), and institutional commitment to sustainability (0.27) directly influence students' environmental values, which in turn have a significant effect on pro-sustainability behaviors. This finding is supported by earlier studies demonstrating the critical role of institutional initiatives in shaping student behaviors. For example, Shriberg (2002) highlighted that sustainability policies in higher education foster environmental awareness, and Lozano (2006) emphasized the role of curriculum integration. Institutional commitment has the strongest influence on students' values (0.36), aligning with Filho's, 2010 findings on the importance of institutional dedication to sustainability efforts. Furthermore, the strong correlation between students' environmental values and pro-sustainability behaviors (0.74) is consistent with Stern's, 2000) research, which showed that values are a significant predictor of environmental behaviors.

Discussion

The pursuit of sustainable practices now shapes social, economic, and environmental choices across everyday life. Encouraging a sustainability culture in educational settings will make students engage, which contributes towards sustainability practice for a better future (Ibrahim et al., 2021). In response to the growing importance of sustainability in educational institutions, it has become essential to examine how students' sustainability practices shape their values and behaviors. Considering that an initiative was taken to look at the comprehensive effects of institutional efforts in the area of sustainability on students' values and behaviors, where an attempt was also made to assess the mediating role of SUEs and the moderating role of HC. As per the results, ISP, SCI, SFEC, and ICS significantly contribute to SEV, which further boosts SPB. This result aligns with the previous studies by Balbin & Balbin, (2024), who emphasized that sustainability curriculum integration of global practices helps students expand their outlook towards the subject matter and prepare them for cultural and geographical contexts. Moreover, Ariesanti et al. (2018) and Assoratgoon & Kantabutra, (2023), also pondered on the fact that such initiatives with active engagement may create a mindset for sustainability among students and enhancing their future behavior and values.

Further, one of the various hypotheses proved SEV to be the major predictor of SPB. In line with the results, Wang et al. (2023) in Chinese context also showed that environmental concern was an important predictor for environmentally responsible behaviors among university students in tourism. Apart from the direct influence of ISP, this study proved that SUE mediates the relationship between institutional efforts and SEV. This result is further justified by previous studies (Cogut et al., 2019; Abramovich & Loria, 2015), which claim that Institutional efforts that promote sustainability education encourages students to go from mere learning to action by accommodating the culture of environmental stewardship. Lastly, one of the interesting findings of this study ponders on the significance of home culture, where home culture (HC) moderated the relationship between students understanding and efforts (SUE) & students' environment values (SEV). This result is in line with previous studies (Swaim et al., 2014; Pimdee, 2020) where authors argue about the relevance of families engaging in sustainable practices, like using air purifying plants, solar installation, and sponsoring an eco-friendly festival, which enhances student understanding that further facilitate environmentally friendly choices. The results clearly demonstrate the importance of institutional efforts, students' understandings and efforts and home culture will have a great impact on students' values and behaviors which lead to sustainability practice.

Practical implications

The present study aimed to understand the involvement of sustainability in educational institutions shaping students' environmental values and behavior. The study imparts that the influence of the inclusion of sustainability in the educational institutional system enables students to become more environmentally responsible. The result reveals a significant influence of individual sustainability understanding and HC impact on the adaptation of suitability practices within themselves.

Managerially, policymakers and institutional administrators need to integrate sustainability concepts into institutional policies, curriculum and even extracurricular activities, which shape students' values and behaviors towards sustainability. The study also proposes to include sustainability holistically into the operations of the universities, such as infrastructure modernizations, sustainability campaigns and student engagement programs, for better implementation of sustainability as it heightens social responsibility in students' behavior. Furthermore, institutions need to offer faculty development grants to use in green curriculum development or implement student team-run carbon audit programs.

Furthermore, the home environment influences students' sustainable behavior. The lifestyle and access to environmental resources, such as organic food and solar energy, motivate students to learn and apply sustainability in their institutions. The institutions and policymakers need to take sustainability education beyond institutions to families and communities through education awareness programs, collaborative initiatives, and parent-student workshops. By mandating students to participate in achieving sustainability goals that encourage students to voluntarily adopt the sustainability practices in everyday life. The findings that students' HC and their environmental values significantly shape pro-sustainability behavior point to clear, actionable pathways for institutions. First, higher education institutions can design family-inclusive sustainability programs. For instance, workshops or community engagement initiatives that invite parents to participate in campus eco-events could reinforce students' learning with consistent practices at home. Second, institutions should embed sustainability into campus life in ways that connect with the lived experiences of students such as linking classroom content with practical projects like household energy audits, community clean-ups, or urban gardening that students can replicate at home. Third, policy measures such as incentives for sustainable commuting, reduction of single-use plastics in campus canteens, and integration of local cultural practices (e.g., traditional water conservation methods) into teaching modules can bridge institutional initiatives with students' cultural backgrounds. Finally, developing peer-led sustainability clubs or student-parent "green ambassador" programs can leverage both social learning and cultural values, ensuring that pro-environmental attitudes translate into lasting behaviors.

By aligning institutional policies with the cultural context of students' lives, universities can move beyond awareness-building toward embedding sustainability as a lived practice. This strengthens the role of HEIs not just as knowledge disseminators but as catalysts of intergenerational change, directly contributing to SDG 4 (Quality Education) and SDG 13 (Climate Action). Students with enhanced substantiality values and behavior play a role model for society by practicing and imbibing sustainability values and behaviors in their everyday lives. This can bring about a positive behavioral change in other demographics in society.

Theoretically, the study provides a notable contribution by expanding the three major theories, i.e., Theory of Planned Behavior (TPB), Value-Belief Norms (VBN) and SLT, into the model that captures institutional efforts shaping student's environmental values and behaviors towards sustainability. The inclusion of the Theory of Planned Behavior has emphasized how institutional policies and infrastructure affect the behavior of the student towards accessible, sustainable action. VBN looks for the institutional culture and governance that can transform aggregate environmental values into individual student's personal norms, thereby enacting their sense of responsibility. Similarly, SLT focuses on learning socially through peer influence, role models, and engagement in activities like eco-clubs or green projects, which makes behavioral change a process involving many, not an individual one. The study mainly contributes to these three theories by integrating the framework that represents cognitive, normative, and social aspects of behavior.

Conclusion

This study explored how institutional sustainability policies, curriculum integration, extracurricular activities, and institutional commitment relate to students' environmental values and behaviors. In the context of developing countries such as India, where higher education institutions often operate under resource constraints and serve diverse student populations, these patterns offer useful direction. The findings indicate that aligning institutional practices with students' everyday cultural experience may help strengthen pro-sustainability behaviors, although further research is needed to confirm how these relationships operate across different types of institutions.

The study adds to ongoing conversations on sustainability in higher education and offers insights relevant to the broader goals of the United Nations SDGs, particularly SDG 4 and SDG 13. While the evidence points to the potential of higher education institutions to encourage more sustainable attitudes and behaviors, the conclusions should be interpreted within the limits of the data and context.

Limitations and future scope

While this study contributes to understanding how students develop values and behaviors related to sustainability, several limitations should be acknowledged. The sample is drawn solely from Karnataka, India, which restricts the geographical scope. Including students from other states or countries would help

determine whether the observed patterns hold across different cultural and institutional contexts.

The cross-sectional design presents another limitation, as it captures perceptions and behaviors at a single point in time. A longitudinal design would offer clearer insights into changes in students' engagement over time.

Methodologically, the study uses only quantitative data. A mixed-methods approach could provide richer insights by uncovering motivations, lived experiences, and contextual barriers that remain less visible in survey responses. The current study does not account for the growing role of digital platforms. Future research could examine how these digital influences interact with institutional efforts to promote sustainable living.

Data availability

The data supporting this study's findings are not publicly available due to confidentiality and other ethical considerations. However, data may be available from the corresponding authors upon reasonable request, provided permission is obtained from the institution.

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Appendix

Table 7, Table 8

Table 7 Rotated component matrix[a].

	Component							
	1	2	3	4	5	6	7	8
HC1	0.778							
HC2	0.769							
HC3	0.747							
HC4	0.741							
HC5	0.735							
HC7	0.723							
HC11	0.723							
HC6	0.713							
HC10	0.701							
HC8	0.655							
HC9	0.632							
PRSB7		0.864						
PRSB1		0.874						
PRSB8		0.849						
PRSB2		0.840						
PRSB9		0.838						
PRSB4		0.823						
PRSB5		0.820						
PRSB6		0.816						
PRSB3		0.792						
ISP5			0.801					
ISP4			0.791					
ISP2			0.790					
ISP3			0.759					
ISP6			0.754					
ISP8			0.695					
ISP1			0.687					
ISP7			0.537					
SUE4				0.761				
SUE3				0.752				
SUE2				0.744				
SUE5				0.739				
SUE1				0.702				
SUE7				0.691				
SUE8				0.687				
SUE6				0.673				
SEI4					0.791			
SEI6					0.789			
SEI3					0.768			
SEI5					0.741			
SEI2					0.715			
SEI1					0.674			
SFEC3						0.769		
SFEC2						0.752		
SFEC5						0.749		
SFEC1						0.732		
SFEC4						0.721		

Table 7 (continued)

	Component							
	1	2	3	4	5	6	7	8
SFEC6						0.685		
ICS3							0.832	
ICS2							0.822	
ICS1							0.791	
ICS4							0.759	
ICS5							0.741	
SEV4								0.774
SEV3								0.754
SEV1								0.738
SEV2								0.736
SEV5								00.689

Extraction method: principal component analysis.
Rotation method: varimax with Kaiser normalization.
[a]Rotation converged in seven iterations.
S.ource: Output of survey data using AMOS.

Table 8 Total variance explained.

Component	Initial Eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	13.901	23.967	23.967	13.901	23.967	23.967	6.970	12.017	12.017
2	9.142	15.761	39.729	9.142	15.761	39.729	6.894	11.886	23.903
3	3.207	5.529	45.258	3.207	5.529	45.258	5.565	9.596	33.499
4	3.006	5.183	50.440	3.006	5.183	50.440	5.043	8.694	42.193
5	2.647	4.563	55.004	2.647	4.563	55.004	3.793	6.540	48.733
6	2.241	3.865	58.868	2.241	3.865	58.868	3.672	6.331	55.065
7	2.077	3.581	62.449	2.077	3.581	62.449	3.093	5.332	60.397
8	1.371	2.364	64.813	1.371	2.364	64.813	2.561	4.416	64.813
9	0.963	1.659	66.472						
10	0.822	1.417	67.889						
11	0.801	1.382	69.271						
12	0.770	1.328	70.598						
13	0.731	1.260	71.858						
14	0.720	1.241	73.099						
15	0.680	1.173	74.272						
16	0.666	1.148	75.420						
17	0.647	1.115	76.535						
18	0.600	1.034	77.569						
19	0.589	1.015	78.584						
20	0.578	0.997	79.581						
21	0.564	0.973	80.554						
22	0.548	0.946	81.499						
23	0.517	0.892	82.392						
24	0.506	0.872	83.263						
25	0.485	0.836	84.099						
26	0.463	0.798	84.897						
27	0.451	0.778	85.675						
28	0.437	0.754	86.429						
29	0.418	0.722	87.150						
30	0.405	0.698	87.848						
31	0.390	0.673	88.521						
32	0.380	0.655	89.176						
33	0.371	0.639	89.815						
34	0.353	0.608	90.423						
35	0.348	0.599	91.022						
36	0.334	0.575	91.598						
37	0.331	0.571	92.168						
38	0.315	0.544	92.712						
39	0.308	0.532	93.244						
40	0.295	0.508	93.752						
41	0.287	0.494	94.246						

Table 8 (continued)

Component	Initial Eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
42	0.280	0.482	94.729						
43	0.272	0.470	95.198						
44	0.262	0.451	95.650						
45	0.256	0.441	96.090						
46	0.252	0.435	96.525						
47	0.247	0.426	96.951						
48	0.231	0.399	97.350						
49	0.228	0.393	97.743						
50	0.208	0.359	98.102						
51	0.199	0.343	98.445						
52	0.194	0.335	98.780						
53	0.190	0.328	99.109						
54	0.181	0.311	99.420						
55	0.174	0.300	99.720						
56	0.162	0.280	100.000						
57	−2.458E-017	−4.239E-017	100.000						
58	−6.585E-017	−1.135E-016	100.000						

Extraction method: principal component analysis.
Source: Output of survey data using AMOS.

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Author contributions

Conceptualisation, Instrument Development & Formal Analysis: Shakira Irfana & Niyaz Panakaje, Review & Theory: Bazigha U M, Babitha Shali Lasrado, Jeevan Raj, Research Methodology: S. M. Riha Parvin, Discussion: Madhura K & Mahammad Shahid, Data Curation: Jeevan Raj, Rashmi H, & Abhinandan Kulal, Writing Original Draft: Shakira Irfana.

Competing interests

The authors declare no competing interests.

Ethical approval

The questionnaire was approved in the meeting of the Scientific Review Board, which scrutinised and deliberated on the application submitted through Approval No. YIASCM/SRB-01/MGT/02/2024 of YIASCM, Yenepoya (Deemed to be University), Mangaluru, under the said policies and procedures for research work of the said university, on 12th August 2024. Written informed consent was obtained from all participants beginning on 15 August 2024, prior to data collection. All procedures performed in this research complied with relevant institutional, national, and international guidelines for research involving human participants.

Informed consent

Informed consent was obtained from all individual participants included in the study. Participation was voluntary, and respondents were informed about the purpose of the study, confidentiality, and their right to withdraw at any stage before consenting. No identifying personal details or images were collected, ensuring full anonymity.

Additional information

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