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The impact of education for sustainable development on university students' sustainability behavior: a case study from undergraduate students in Somalia

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Education plays a crucial role in moving towards a sustainable future. The United Nations Decade of Education for Sustainable Development has advocated education for sustainable development (ESD) to promote global sustainability. UNESCO supports ESD as a way to provide society with the knowledge, skills, values, and attitudes needed for sustainable living. While considerable progress has been made in many developed countries, particularly in higher education institutions, and to some extent in developing countries, similar success has not been observed in Somalia's higher education establishments. This study examined the influence of ESD on university students' conduct in Somalia. Through cluster sampling, 251 students from SIMAD and Hormuud Universities in Mogadishu were chosen to participate by completing a questionnaire. The research revealed a significant positive connection between ESD and students' behavior. The findings emphasize the importance of integrating ESD into higher education curricula to encourage cultural norms that endorse environmentally friendly practices. This investigation offers valuable insights for academics, policymakers, and businesses seeking to advance sustainability within educational settings and beyond.

KEYWORDS

sustainability, SDGs, education, higher education, student, behavior, Somalia

1 Introduction

The United Nations (UN) Agenda 2030 states that global transformation and universality are necessary for sustainable development. "Universality" refers to sustainable development, which calls for meeting global issues such as inequality between nations, climate change, and regional economic, social, and environmental goals. Governments and international organizations must address these complex concerns to enable necessary "transformative" changes in the way of life and environmental protection (Bastianoni et al., 2019). Education

plays a crucial role in sustainable development and the environment. Global environmental discussions are well-documented through international events such as the United Nations Conference on Human Environment in 1972, the Intergovernmental Conference on Environmental Education in 1977, the World Conference on Environment and Development in 1987, the United Nations Conference on Environment and Development in 1992, the International Conference on Environment and Society in 1997, and the World Summit on Sustainable Development in 2002 (Manteaw, 2012).

It has been observed that education, in all its various forms from elementary to tertiary levels, plays a distinctive and pivotal role. The global initiative for sustainable development is likely to experience significant growth due to the UN Sustainable Development Goals (Shiel et al., 2016). Education for sustainable development (ESD), also known as Education for Sustainability, is a concept aimed at comprehending and reshaping educational systems to foster sustainability within higher education institutions. Its goal is particularly centered on shaping the mindset, values, and actions of future generations (Zguir et al., 2021). However, various strategies are essential to guarantee that ESD develops appropriately locally while considering notable cultural differences (Wals, 2014). Since education is included explicitly in at least five SDGs, it is possible to argue that education and all the other goals are intimately related (UNESCO, 2017).

The increasing number of academic programs focused on sustainability from global universities reflects the modern prominence of sustainability and environmental science (Wiek et al., 2011). Changes in behavior are necessary to achieve sustainability objectives since they have a substantial impact on humans. In this sense, people's consumption patterns—which include the need for necessities like food, fuel, water, wood, minerals, and materials—are fundamental. There is broad consensus that resource overuse and environmental degradation cause irreversible changes to our world. Home consumption contributes 50–80% of global land, material, and water usage and about 60% of greenhouse gas emissions (Ivanova et al., 2016). According to UN Food and Agriculture Organization (FAO) estimates, one-third, or around 1.5 billion tonnes, of the food produced worldwide is wasted (FAO of the United Nations, 2013). Furthermore, as population growth and resource demand increase, it is predicted that in <15 years, the water demand will exceed the availability by 40% (Programme UNE, 2017).

In addition to reducing environmental problems, limiting unsustainable behaviors encourages sustainable development. Therefore, education is critical because it can change people's behavior. It is often acknowledged that influencing students' views toward the environment depends on providing them with suitable attitudes, values, responsibilities, and abilities from an early age (Mahat et al., 2017). According to Geng et al. (2017), teenagers and young adults are more open-minded, more accessible to teach sustainable activities, and more likely to encourage others to adopt sustainable practices (Geng et al., 2017). Furthermore, students are the next generation of decision-makers, educators, and policymakers responsible for environmental management (Joshi and Rahman, 2017; Tan and Lau, 2009).

Although ESD existed before the SDGs (Hjorth Warlenius, 2022), it has emerged as a pivotal instrument within the present SDG agenda to reorient learning toward a more sustainable world

and tackle economic, social, and environmental challenges (Stein et al., 2022). Several universities have started implementing several principles to help administrators in higher education find and implement complex solutions for future responsible management. These principles also ensure that students receive the education necessary to support sustainable development and lifestyles (Borges et al., 2017). On the other hand, higher education's importance in advancing ESD is widely acknowledged (Liu et al., 2022). Higher education institutions (HEIs) are recognized as critical players in the SDGs' advancement due to their diverse contributions to research, pedagogy, campus administration, and community engagement. In addition, they facilitate the integration of knowledge from other fields, and develop the interdisciplinary abilities necessary for developing a sustainable future in subsequent generations (Oyedepo et al., 2020). Higher education also helps students enhance their multidisciplinary cooperation, anticipatory skills, problem-solving ability, creative thinking, and social responsibility—all critical for accomplishing the Sustainable Development Goals (SDSN, 2020).

In the Somali setting, it is crucial to prioritize education on sustainability. Somalia encounters distinctive environmental obstacles such as deforestation, desertification, and the effects of climate change that endanger the livelihoods and welfare of its people (Melesse and Obsiye, 2022). Sustainability education should be integrated more extensively than solely acquiring knowledge, entailing a transformative, participatory learning process that aligns behavior with knowledge (Hammer and Lewis, 2023). However, this research is timely and significant as it coincides with Somalia's efforts to rebuild its higher education sector, presenting a crucial opportunity to embed sustainability principles that will influence the country's future development. Aligning Somali higher education institutions with international sustainability standards is essential amidst the global push for sustainable development.

This research aims to fill a significant gap in the study of how ESD influences student behavior within Somali higher education institutions. Despite global recognition of the importance of sustainability education (Nejati and Nejati, 2013), there is limited empirical evidence on its impact in Somali contexts, especially in post-conflict settings like Somalia. The novelty of this study lies in exploring how ESD integration affects university students' adoption of sustainable practices at SIMAD and Hormuud Universities, aiming to provide insights that can guide future sustainability initiatives tailored to these educational settings. Understanding these dynamics is essential for addressing the region's urgent environmental and socio-economic challenges while promoting long-term sustainable development.

2 Literature review

Since the 1972 UN Conference on the Human Environment, higher education institutions have actively pursued initiatives to promote sustainable development (Amaral et al., 2015). The academic focus on students' sustainability abilities progressively expanded over many years (Wu and Shen, 2016). In Spain, researchers investigated the correlation between adopting sustainable consumption and seven competencies: self-regulation, leadership, perspective, humility and modesty, kindness, and appreciation of beauty. They demonstrated

that cultivating ethical competencies through education promotes the adoption of sustainable consumption practices among students (Okubo et al., 2021).

Sustainable development is mainly integrated into higher education in two ways. The first one is to include it throughout all school curricula, and the second is to train staff and students to become sustainability experts (Liu et al., 2022). Curriculum change, regional and worldwide partnerships, and sustainable campus initiatives have been organized to endorse ESD in higher education institutions (Vaughter et al., 2013). Universities have promoted sustainability initiatives in their academic programs and infrastructure (Findler et al., 2019). An increasing focus is placed on cultivating students' proficiencies in systems thinking competency, anticipatory competence, normative competence, strategic competence, and interpersonal competence (Cebrián et al., 2020; Cebrián and Junyent, 2015; Liu et al., 2022).

University students must receive education to understand and address social, environmental, and economic challenges while promoting collaboration to execute coordinated initiatives (McNall, 2011; Weber and Duderstadt, 2012). From an educational perspective, this involves establishing meaningful human connections that result in significant learning to address socio-environmental challenges during the academic journey (Núñez, 2014). Universities have a significant impact on shaping the behavior of their students, utilizing resource use competitions and sustainability programs conducted on campus (Filho, 2011). Achieving sustainable development demands more than just environmental initiatives; it requires a fundamental shift in human behavior to address today's pressing sustainability issues (Badwan et al., 2022). It also requires a profound understanding of individuals' decision-making processes, actions, thoughts, interactions, beliefs, and attitudes (United Nations, 2016).

Berchin et al. (2018) outline six approaches that higher education institutions use to embrace sustainability, including setting institutional agendas for sustainability, conducting research, teaching sustainable practices, managing campus operations sustainably, engaging in outreach activities, and disseminating knowledge. They also emphasize the promotion of recycling behavior, critical thinking skills, innovative technologies adoption and fostering open dialog among science professionals, industry experts and society members. Barros et al. (2020) highlighted the significance of educational institutions prioritizing changes in the behavior of students and instructional staff to advance sustainability efforts. Also Ahamad and Ariffin (2018) emphasized that simply imparting knowledge about sustainable behaviors to students is inadequate because earning a university degree does not guarantee their adoption of such behaviors.

UNESCO coordinates the development of policies and strategies for integrating ESD into national education systems on behalf of governments and global stakeholders (Hjorth Warlenius, 2022). Despite their key role, numerous academic scholars have questioned their perspective regarding the behavioral change as result of ESD. This argument is based on the premise that this outcome is intrinsically more conducive to instruction-based learning (Syed-Abdullah et al., 2023). Scholars continue to be concerned that when behavior modification becomes the objective, the fundamental learning processes, and motivations for doing so may be called into question (Syed-Abdullah et al., 2023). Such a concept, Bourn and Soysal considers education to be fundamentally transmissive. The term

"transmissive" refers to actions or behaviors that are generated in accordance with a predetermined set of knowledge, skills, and values that are promoted by industries, special interest groups, governments with preferred messages, agendas, ideologies, or consumer preferences (Bourn and Soysal, 2021).

An additional factor is noteworthy to our investigation. Syed-Abdullah et al. (2023) emphasize that an extensive body of literature indicates that individuals rarely change their behavior according to a logical impetus. This further exposes the weaknesses of transmissive approaches, as the literature also indicate that learning and understanding are not enough to inspire a commitment to sustainable behavior (Shehzad et al., 2024). Experts on ESD argue that pre-established educational outcomes would restrict the opportunity for independent thought and reflective self-determination regarding academic achievements (Syed-Abdullah et al., 2023). Therefore, the search for rational solutions within a broader context is highly important (Kvamme, 2020). Considering this concept, literature emphasize that imparting knowledge and fostering critical thinking skills are crucial components of a transformative education (Alam, 2022).

Experts advocating for a transformative approach to ESD emphasize that behaviors are influenced by processes of social reproduction, social efficiency, and confronting global injustices, which demands proper judgment in determining which ethical values are right or wrong within specific contexts (Kvamme, 2020). For instance, recycling has been characterized in numerous studies as an environmentally beneficial practice that warrants promotion (de Leeuw et al., 2015). According to Hopewell, Dvorak, and Kosior, "in the first instance, methods that reduce the use of materials in products can reduce the amount of material entering the waste-management system" (Mourshed et al., 2017). According to this perspective, endorsing recycling may inadvertently reinforce mis-educative behavior, because, from a lifecycle analysis perspective, first minimizing material consumption is more advantageous.

Madar et al. (2019) and Syed-Abdullah et al. (2023) provide valuable insights by differentiating between transmissive and transformative approaches of ESD. The transmissive ESD encourages "well-informed and proficient behaviors and thought processes," whereas the transformative ESD, advocates for "developing the ability to think critically beyond experts' opinions and investigating the inherent contradictions in sustainable living." Although they acknowledged the significance of both approaches, they contend that transformative ESD is more crucial because our long-term prospects will be determined less by our obedience to training in doing the "right" thing in the present and more by our capacity to analyse, question alternatives, and negotiate our decisions (Madar et al., 2019).

On the other hand, teacher quality in integrating sustainability concepts into classroom activities in many developing countries has been commonly criticized, leading to teacher sustainability education reform in many countries. For instance, Thailand has numerous initiatives and schemes to enhance the education system, particularly in training both student teachers and qualified educators. These initiatives prioritize enhancing competent professional skills, addressing global challenges, and mastering technological utilization (Vermeulen et al., 2014). Teachers must possess the necessary knowledge, awareness, competency, and appropriate behavior to create learning opportunities for their students, as they are essential

in facilitating understanding and awareness of sustainability within the educational system.

In addition to improving teacher quality, various studies have been undertaken on campus sustainability to measure and improve the environmental impact of educational institutions. For example, research has focused on measuring the carbon footprint of student and teacher transport, promoting the use of energy-efficient modes of transportation like bicycles or public transport, and encouraging practices such as turning off lights in empty classrooms (Barros et al., 2018; Jain et al., 2013). Concurrently, researchers like Marinho et al. (2014) and Geng et al. (2013) have emphasized activities aimed at reducing water usage, improving water treatment in universities, and promoting tree planting, respectively. These efforts highlight the importance of addressing practical sustainability challenges on campus. Additionally, alternative methods aim to identify the primary obstacles to integrating sustainability-related subjects into academic curricula Andrades Peña et al. (2018), ensuring that both theoretical and practical aspects of sustainability are incorporated into education.

To understand the multidisciplinary nature of sustainability challenges, students must engage in experiential learning facilitated by pedagogical methods that enhance their connection to real-world scenarios (Banos-Gonzalez et al., 2018). In this regard, researchers have proposed various methods for learning, including social constructive pedagogy, experiential learning, field-based travel courses, outdoor adventure trips, and more (Badea et al., 2020). The literature review highlights that the subject gains attention beyond academia, inspiring considerable debate due to the lack of consensus. Furthermore, it serves as a focal point for numerous studies, particularly concerning the attitudes and behaviors of university students regarding the implementation of ESD principles.

3 Materials and methods

The research was conducted at SIMAD University and Hormuud University in Mogadishu, Somalia, involving undergraduate students from the Faculty of Economics. These faculties were chosen due to their focus on areas related to sustainability, including resource management, environmental economics, and corporate social responsibility. Given that these subjects inherently involve aspects of sustainability education, the study considered economic students as a suitable cohort for investigating the impact of sustainability education on behavior. As of the 2023/2024 academic year, there is a total student population of 750 across both faculties. Further information about data collection and analysis methods will be provided below.

3.1 Item development

The questionnaire of this study contains five sections addressing concerns about the environment (CE), the culture of the environment (CUE), warning (W), reuse (R), and a section intended for respondents' demographic background. These sections draw upon items adapted, revised, and added from previous studies (Ahamad and Ariffin, 2018; Boca and Saraçli, 2019). The chosen objects correspond to four components of ESD: enhancing quality of life, ensuring environmental protection, resource efficiency, and addressing the

demands of future generations (Ahamad and Ariffin, 2018). These four components is aimed to ensure that the questionnaire is inclusive. There are 10 items in the independent variables (CE, CUE, W) and three in the dependent variable, namely student behavior (R). The total number of items was adjusted accordingly after subsequent validity and reliability tests were taken.

3.2 Item validity and reliability

Before distributing the questionnaires to the sample population, the questionnaire was content-validated and tested for reliability. Item content validity was assessed using the item content validity index (I-CVI). This process involves a team of experts indicating the relevance of items contained in a questionnaire (Polit and Beck, 2006). Therefore, the questionnaire was distributed to four academicians with expertise in or relevant to ESD. They were requested to rate, comment, and suggest item improvements.

After receiving comments and suggestions from the experts, revision was made. The experts' comments and suggestions were considered, and the questionnaire items were revised accordingly (Lynn, 1986). Among the suggestions was to remove a few items that showed duplication, and adjustments were made to the structure to align with the experts' recommendations. Subsequently, the items were adjusted to 17, including the demographic items as encouraged.

Later, a pilot test involving 20 respondents was undertaken to confirm the reliability of the questionnaire. The internal reliability and consistency of questions were tested using Cronbach's alpha. Cronbach's alpha values for all four sections have acceptable internal consistency (CE, CUE, and W) and (R).

3.3 Sampling size and method

The sample size was determined using the Bin Ahmad and Binti Halim (2017) formula, where an additional 5% of the sample size was added to account for potentially incomplete questionnaires. A total of 267 self-administered questionnaires were disseminated via Google Forms among undergraduate students across Faculties of Economics at SIMAD and Hormuud Universities. We received 251 responses out of the 267 we targeted. The selection process for the study population involved cluster sampling, whereby faculty staff provided information regarding the total number of students enrolled in each faculty. Participation in the study was entirely voluntary, and the criteria for inclusion required that participants be currently enrolled undergraduate students in the Faculty of Economics at either SIMAD or Hormuud University; graduated students were not allowed to participate. Students were approached in the classroom to complete the questionnaire fully. The confidentiality and anonymity of the responses provided by the participants were strictly maintained.

3.4 Data analysis and results

The study utilized structural equation modeling with SmartPLS4 to assess both the measurement and structural model (Henseler et al., 2015). The researchers of this study investigated the proposed paths and confirmed the findings. Structural equation modeling using

SmartPLS4 encompasses a range of statistical techniques for examining potential relationships between independent and dependent variables (Lee et al., 2011). It is characterized by two sets of linear equations: the structural model, which elucidates the connections between constructs, and the measurement model, which illustrates the interactions between a construct and its observable indicators. The researchers selected SmartPLS for two primary reasons: firstly, PLS is a more suitable approach for our investigation as it is exploratory in nature. Secondly, it has gained significant recognition across scientific disciplines recently (Sarstedt and Cheah, 2019). Utilizing hypotheses testing in research to uncover causal relationships was commonly considered appropriate (Restuputri et al., 2021).

3.5 Research model

The diagram in Figure 1 describes a research model that is developed based on the study's objectives, hypotheses, and existing literature. This model encompasses various important variables including environmental concerns (CE1, CE2, CE3, and CE4), cultural environment (CUE1, CUE2, and CUE3), attitudes toward environmental warnings (W1, W2, and W3) as well as the practice of "reuse" with its three components (R1, R2, and R3). The research employs Structural Equation Modeling to examine the eco-friendly behaviors of university students and explore the causal connections between their environmental attitudes and their real actions. The SEM framework integrates both behavioral aspects along with attitudinal ones. Additionally, the research model incorporates provisions for testing three hypotheses which are detailed in Table 1.

4 Findings of the study

4.1 Demographic profile

Based on the demographic information provided by the participants, it can be observed that 54.2% of the sampled respondents identify as male, while 45.8% identify as female. Concerning age

groups, 86% of the sample consists of participants aged 18–22. Concurrently, 14% of the respondents were between the ages of 22 and 25. All participants in our study were undergraduate students who had recently completed secondary education, and none were older than 25.

Regarding marital status, the study's sample was predominantly composed of single respondents, at 96%. Married respondents constituted a mere 4% of the total. As indicated in Table 2, most research participants (70% of all respondents) were in the last years of their bachelor's degree, while 30% were in the first years of their bachelor's degree (Diploma).

4.2 Assessment of the measurement model

Using SmartPLS 4, a confirmatory factor analysis was employed to validate the psychometric properties of the instruments (refer to Table 3). The assessment of the measurement model included average variance extracted, composite reliability, discriminant validity, and convergent validity. Table 3 demonstrates that most factor loadings for the variables' measuring items were ≥0.70, except for one item. Furthermore, both "average variance extracted" and "composite reliability" values exceeded 0.50 and 0.70, respectively, for all latent variables in the research study. These results indicate strong reliability and validity of the research measurement model with factor loadings surpassing 0.70, as well as AVE and CR values exceeding their respective thresholds across all study variables.

Table 3 presents the findings of confirmatory factor analysis that support the psychometric characteristics of the assessment tools. The measurement model was assessed using average variance extracted, composite reliability, discriminant validity, and convergent validity. The results in Table 3 indicate that the factor loadings for the items measuring variables were consistently above 0.70. Moreover, both "average variance extracted" and "composite reliability" values for latent variables exceeded 0.50 and 0.70, respectively, across all research variables, demonstrating high reliability and validity of the research measurement model with strong factor loadings exceeding 0.70 as well as AVE and CR values surpassing thresholds for all study variables.

The fact that each latent variable differs from the others shows that the test is discriminately valid. This statement supports the idea that the measurement model captures different aspects of the phenomena
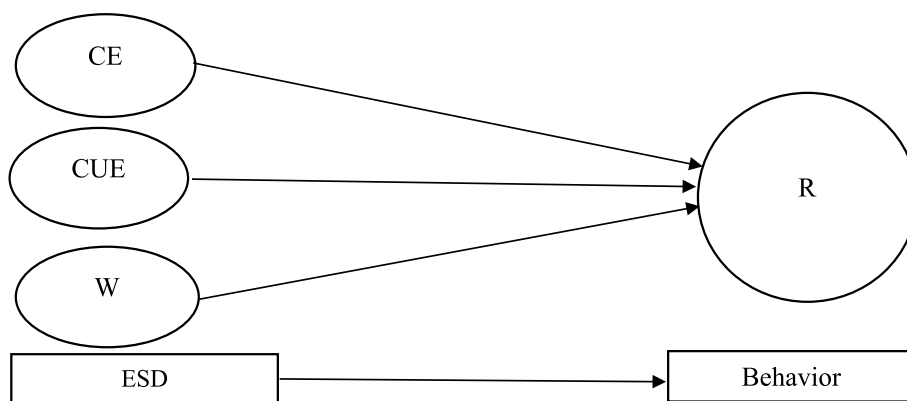

FIGURE 1
Research model. Source: by author.

TABLE 1 Hypotheses tested by the attitude of students.

H1: Students' attitudes to the concern of the environment have a significant effect on their reuse behavior.
H2: Students' attitudes to the cultural environment significantly affect their reuse behavior.
H3: Students' attitudes toward warning significantly affect their reuse behavior.

TABLE 2 Demographic characteristics of respondents ($N = 251$).

Character	Frequency	Percent
Gender		
Male	136	54.20%
Female	115	45.80%
Age (in years)		
18–22	216	86%
22–25	35	14%
Marital status		
Single	241	96%
Married	10	4%
Education		
Diploma	75	30%
Bachelor	176	70%

under investigation (Rönkkö and Cho, 2022). It proves that the questions successfully evaluated the intended constructs and supported the validity of the research tools. It suggests that the items chosen are appropriate for measuring the variables in this study.

Table 4 illustrates the utilization of the Fornell-Larcker criterion by the researchers to evaluate discriminant validity. The outcome presents the associations between the latent constructs in the study model. The Fornell-Larcker criterion involves comparing a construct's square root of Average Variance Extracted to its correlations with all other constructs, where each construct's AVE must exceed the squared correlation with any other construct for it to pass the test of discriminant validity construct (Fornell and Larcker, 1981). With support from the Fornell-Larcker criterion indicating discriminant validity and no instances of cross-loading surpassing corresponding loadings, this investigation favors discriminant reality as evidenced in Table 4.

The Heterotrait-Monotrait Ratio (HTMT) is one of the most valuable indicators for measuring discriminant validity when employing SmartPls4 (Henseler et al., 2015). The HTMT values in Table 5 support the conclusions drawn from the Fornell-Larcker criterion. The values for the complete model in this investigation were 0.9 or less, as shown in Table 5 and Figure 1. These results suggest that the measurement model possesses discriminant validity, thereby strengthening the overall reliability of the measurement model (Figure 2).

4.3 Assessment of the structural model

The findngs of the study are displayed in Table 6. The structural pathways were evaluated using the Bootstrapping technique, and 5,000 sub-samples were utilized to examine the proposed connections. The β-coefficient, t-value, and p-value were employed to validate the suggested associations. The overall model adequacy was assessed utilizing the coefficient of determination, R^2. As indicated by Figure 3, the R^2 indicated a 0.795% variation in student sustainability behavior due to all independent variables studied in this research such as concern for the environment, cultural environment, and attitude toward environmental warnings. In general terms, student conduct in higher education shows a positive and significant connection with concern for the environment ($\beta = 0.277$; $p = 0.027$), cultural environment ($\beta = 0.310$; $p = 0.017$), and attitude toward environmental warnings ($\beta = 0.530$; $p = 0$).

The findings of this study support the acceptance of all three hypotheses, indicating a statistically significant positive correlation between concerns about the environment, cultural environment, warning attitudes, and the sustainability behavior of university students in Somalia. These findings align with previous empirical support for the perception that education for sustainability has a positive correlation with university students' adoption of sustainable practices (Boca and Saraçli, 2019).

5 Discussion

This study investigated how ESD affects the behavior of university students in Somalia. The study's results emphasize the importance of education for sustainability in developing sustainable behaviors among university students in Somalia. The structural model confirmed that sustainability education (including environmental concerns, cultural environment, and warning attitudes) significantly correlated with university students' sustainability behavior (specifically, reuse behavior). Higher education institutions are crucial in advancing sustainable development through significantn-campus activities that positively impact the environment and society (Badea et al., 2020). The involvement of students in sustainable practices promotes their attachment to the campus community, extends their desire to participate in campus initiatives, and facilitates a significant change through their behavior (Krasny and Delia, 2015).

Our research shows that students' perceptions of sustainable development efforts on campus positively affect all items of sustainable behavior investigated. These findings align with the broader literature, highlighting the importance of sustainability education in shaping sustainable practices. The correlation between individual worries regarding air pollution and the willingness to participate in environmental stewardship is robust, consistent with the results of prior research that underscore the significance of perceived personal relevance in motivating environmentally conscious conduct (Steg, 2016). According to research by Kollmuss and Agyeman (2002), people are more persuaded to embrace sustainable practices when they perceive immediate personal advantages or consequences. Therefore, our findings underscore the potential effectiveness of targeted messaging and interventions that emphasize the pressing importance of environmental issues to people's lives.

Moreover, the participants' acknowledgement of global environmental difficulties, such as biodiversity loss, shows a deep understanding of how environmental issues are interconnected and their significant impact on the planet's long-term viability. This finding

TABLE 3 Factor loadings, reliability, and validity.

Factors	Items	Loadings	CR	AVE
CE	Concern about the environment			
CE1	I am concerned about the effects of air pollution on me	0.972		
CE2	I have never had serious concerns about issues like marine pollution	0.919		
CE3	I do not believe that the extinction of animals and plants will destroy the world	0.964	0.978	0.916
CE4	It annoys me to see that factory wastes cause environmental pollution	0.972		
CUE	Culture environment			
CUE1	I will check and switch off unnecessarily used lights	0.773		
CUE2	I will use the back of papers when I am studying	0.817	0.961	0.930
CUE3	I will warn those polluting nature	0.966		
W	Warning			
W1	I will warn those harming trees and flowers in parks and gardens	0.644		
W2	I will warn those in my immediate vicinity to	0.791	0.805	0.582
W3	I will fight those endangering nature	0.839		
R	Reuse			
R1	I buy ecological products, although they are in parks and gardens	0.943		
R2	I am buying products with recyclable packaging	0.882	0.926	0.807
R3	I buy the products of companies that are backing environmental projects	0.868		

TABLE 4 Inter-construct correlation (Fornell-Larcker criterion).

	CE	CUE	R	W
CE	0.957			
CUE	0.947	0.904		
R	0.738	0.711	0.898	
W	0.316	0.261	0.699	0.763

TABLE 5 Heterotrait-monotrait ratio (HTMT).

	CE	CUE	R	W
CE				
CUE	0.816			
R	0.789	0.790		
W	0.509	0.583	0.838	

is consistent with research highlighting the importance of promoting systems thinking and fostering a sense of global citizenship to promote sustainable behavior (Wals and Jickling, 2002). Increasing people's awareness of the impact of their actions on global sustainability can enhance their sense of responsibility and motivate collaborative efforts to tackle urgent environmental issues.

The participants' feeling of prioritizing eco-friendly options, such as ecological products and those with recyclable packaging, demonstrates a rising inclination toward ethical consumerism and responsible consumption. Studies have shown that customers increasingly consider environmental and social factors when purchasing, indicating a shift toward more sustainable consumption habits (White et al., 2019). The results underscore the necessity for policymakers and business leaders to support sustainable production and consumption due to the growing consumer demand for

environmentally friendly options. The participants' support for businesses that endorse environmental activities highlights the importance of corporate social responsibility (CSR) in shaping consumer attitudes and actions (Ahamad and Ariffin, 2018). Consumers are more motivated to support businesses committed to environmental sustainability and social responsibility (Du et al., 2010). Therefore, businesses prioritizing environmental activities enhance their market competitiveness, brand reputation, and sustainability. The study offers significant contributions to academic understanding and practical implementation of sustainable practices in educational environments by shedding light on the determinants of sustainability-related behavior among university students in Somalia.

This research extends current knowledge by providing empirical evidence from a region that has been underrepresented in sustainability education studies. The study highlights the unique challenges and opportunities within this context by focusing on Thai higher education institutions, enriching the global discourse on ESD. The study contributes to understanding how specific components of sustainability education interact to influence student behavior, offering a more nuanced view of the mechanisms driving behavioral change. The findings of the study suggest a requirement for Somali universities to incorporate ESD more extensively into their academic programs. Policymakers and educational leaders should give importance to creating and executing courses and initiatives that integrate sustainability principles throughout various fields of study. Additionally, hands-on activities like projects centered on reusing and recycling should be included to offer practical experience and strengthen theoretical understanding.

Enhancing the quality of teachers through specialized training programs in sustainability education is essential for advancing educational achievements in Somalia. Educators must possess the
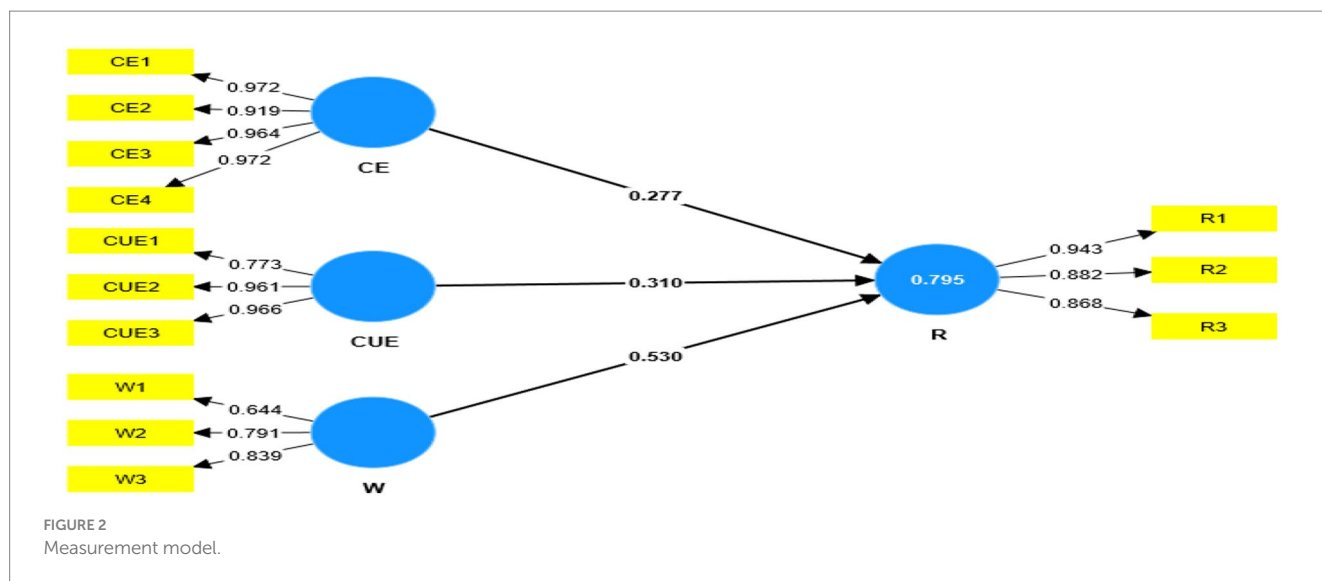
FIGURE 2
Measurement model.

TABLE 6 Hypotheses testing results.

Hypotheses	Relationship	Beta (β)	STDEV	t-value	p-values	Findings
H1	CE->R	0.277	0.125	2.215	0.027	Accepted
H2	CUE->R	0.31	0.13	2.379	0.017	Accepted
H3	W->R	0.53	0.025	21.331	0	Accepted

necessary expertise and skills to integrate ESD into their teaching strategies effectively. These training initiatives should also consider the unique cultural and contextual elements relevant to Somalia to ensure their relevance and effectiveness. Key components of these professional development efforts include organizing engaging activities that cultivate environmental awareness, facilitating workshops to enhance personal and community-level understanding of global responsibility, and encouraging active participation in sustainability projects.

Universities are responsible for championing and supporting on-campus sustainability initiatives involving students in practical, hands-on sustainable practices. These efforts provide valuable learning opportunities for students to apply their classroom knowledge in real-world settings. By promoting student-led sustainability projects, universities can foster a sense of ownership and participation, thus promoting the adoption of sustainable behaviors within the campus community. Integrating project-based learning (PBL) models into sustainability curricula can help students develop critical thinking, problem-solving, and collaboration skills necessary to address complex sustainability challenges.

# 6 Conclusion and policy recommendations

This empirical research examined how ESD influences the sustainable behavior of university students in Somalia. ESD programs have been shown to dramatically impact students' attitudes and behaviors toward sustainability thorough investigation and

examination of many elements. This study emphasizes the significance of including sustainability education in higher education courses. Somali universities have the potential to cultivate a culture of environmental awareness and responsibility among future leaders by introducing ESD to their students. These efforts not only help in the advancement of a sustainable society but also support worldwide initiatives for environmental protection and preservation.

Findings from this study emphasize the importance of continuous research and advancement of ESD programs to guarantee their effectiveness and applicability in tackling environmental, social, and economic issues. Universities can enhance their influence on students' behavior and foster continued positive change in communities by consistently improving and adjusting educational methods (Ahamad and Ariffin, 2018). ESD significantly influences students' behavior toward environmental sustainability in Somalia. However, universities can positively use their infrastructure and expertise to advance ESD in collaboration with other educational institutions, government levels, and the broader community.

The study recommends that higher education institutions in Somalia consider prioritizing sustainability education initiatives. This suggestion stems from the positive connection between sustainability education and students' adoption of sustainable practices. Universities can prioritize these activities by integrating sustainability courses into academic programs and organising extracurricular activities to promote social and environmentally conscious behaviors among students. The study also encourages higher education institutions to explore integrating sustainability ideas throughout all academic disciplines. This holistic approach can equip students with a deep understanding of environmental issues and sustainable solutions. By

FIGURE 3
Structural model.
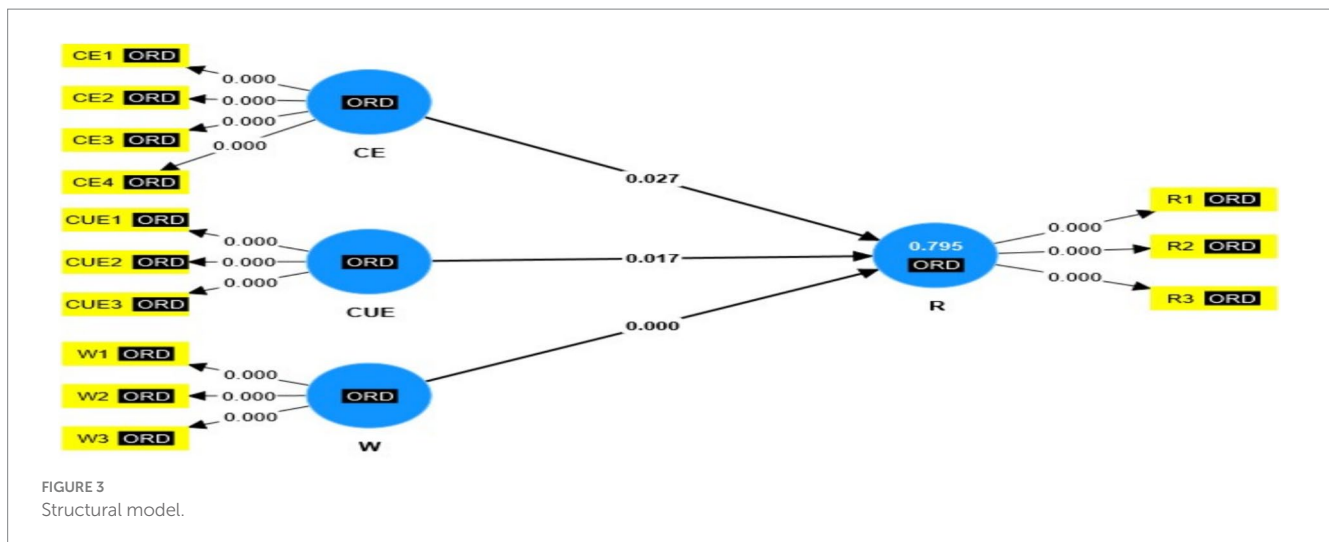
adopting a multidisciplinary approach, students can cultivate a comprehensive perception of sustainability, potentially fostering their motivation to integrate sustainability concepts within their fields of study.

Empowering students to initiate sustainability efforts like recycling programs, green initiatives, and community projects can strengthen their connection to the campus community and motivate significant changes in behavior. Universities should foster a culture of sustainability on campus by offering a variety of on-campus activities. Universities should create thorough sustainability strategies that cover energy efficiency, waste reduction, water conservation, and sustainable transportation, involving stakeholders in the execution and oversight. They must also allocate resources toward educational and outreach initiatives to increase awareness and encourage behavioral changes among students, lecturers, staff, and the wider community. The programs should include sustainability workshops, seminars, campaigns, and educational resources to empower individuals to embrace more sustainable lifestyles and activities.

6.1 Limitations and future research

The research was carried out at the faculties of economics in SIMAD and Hormuud Universities. This focus was selected for multiple reasons, despite its limitation on generalizing the results. Firstly, students at these faculties have been introduced to sustainability concepts through specific courses within their academic programs. These courses aim to impart an understanding of economic principles alongside sustainable development practices. By concentrating on students who already possess some knowledge of sustainability, the study aimed to evaluate how this education influences their behavior and establish a clearer link between ESD and behavioral changes. Secondly, the faculties of economics were chosen because economic students often interact with subjects that intersect with sustainability, such as resource management, environmental economics, and corporate social responsibility. These topics naturally incorporate elements of sustainability education, making these

students an ideal group for examining how sustainability education affects behavior.

While this focus restricts generalization of the findings to all university students in Somalia, it provides valuable insights into the effectiveness of sustainability education among a group already familiar with these concepts. In the future, there is an opportunity for broader research covering diverse universities and faculties for comparative analysis of students' perceptions, attitudes, and sustainability behavior. Expanding studies on ESD can deepen cultural impacts on environmental decision-making and support effective strategies in ESD. It should be noted that this study relied on self-reported data possibly affected by response bias and social desirability effects. Future research could incorporate mixed methods involving qualitative and quantitative tools better to understand the underlying relationship between ESD and sustainability behavior. The sustainability and cross-cultural research fields may yield ineffective strategies for addressing environmental problems prevalent in our society. Investing in targeted professional development programs can equip Somali educators with the necessary knowledge and skills to effectively integrate ESD into their teaching. Such programs should address the technical aspects of sustainability education and the cultural and contextual factors specific to the Somali context to ensure relevance and effectiveness.

Findings from studies conducted in other developing countries like Pakistan suggest that the implementation of ESD in higher education institutions remains low, and teachers often lack adequate knowledge of sustainability concepts (Vilmala et al., 2022). Similarly, research from the UAE indicates a need to investigate the status of ESD and sustainability literacy among tertiary students, as they are key agents of change in addressing environmental issues. Therefore, designing tailored professional development for Somali teachers can help bridge this gap and empower them to become champions of sustainability education (Rukmana et al., 2023). Integrating sustainability education into Somali classrooms requires a comprehensive approach that considers both the pedagogical and contextual factors. Professional development programs should focus on building teachers' content knowledge and pedagogical skills to

deliver ESD effectively. Additionally, these programs must be designed with a deep understanding of the cultural, social, and environmental realities of Somalia to ensure the relevance and impact of the training.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

AA: Writing – original draft. HH: Formal analysis, Software, Writing – original draft. MA: Methodology, Writing – original draft. OH: Conceptualization, Writing – review & editing. AW: Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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