Sustainability and Environmental Education Complications in Modern Higher Education Perspectives

Abstract:

This review article offers an examination of Sustainability and Environmental Education (SEE) in higher education, focusing on the numerous challenges that prevent effective integration and possible solutions. The world's environmental issues have reached an urgent point, making it essential for universities to achieve sustainability and environmental stewardship. While the importance of SEE is beginning to be understood on a broader level, universities struggle to integrate sustainability into their core work. Aspects of these challenges include the integration of SEE into the curriculum, institutional support and resource constraints, governance and policy issues, student engagement, and sustainable practice on campuses. This study blends the existing body of literature to identify important challenges and suggest ways forward. Universities can be compelling in developing sustainability and environmental stewardship through the development of comprehensive SEE, addressing resource constraints, aligning governance and policy to sustainability goals, enhancing student engagement, and enacting sustainable practices on their campuses. Future research can help higher education continue to make leading contributions to global environmental issues by examining ways to develop creative solutions and systems for SEE. This study indicates that a collaborative and holistic approach is necessary to work through the complexities impacting SEE integration and ultimately contribute to a more resilient and sustainable future.

1. Introduction

In recent years, the world has experienced clear and pressing environmental challenges, necessitating that universities support sustainability and environmental responsibility [1], [2]. Universities, through research, teaching, and community engagement, can offer unique solutions to some of the most significant global challenges, including habitat loss, resource depletion, and climate change [3]. A significant area of higher education's curriculum, sustainability and environmental education (SEE) focuses on positioning students with the values, knowledge, and skills to anticipate and resolve environmental challenges [4]. However, there are several challenges and barriers to incorporating SEE into higher education, including challenges with engaging students, organizational structures, governance and policy, integrating SEE into the curriculum, and ensuring sufficient resources. The role of SEE in higher education is fundamental. The need for informed individuals capable of advocating for sustainable practices and policies has never been greater, as the planet experiences more complex environmental challenges [5]. Universities, as institutions are uniquely positioned to engage the next generation of professional and social leaders to infuse sustainability within their core functions [1]. Educating students about environmental challenges is only one area, but developing a sustainable culture that permeates every aspect of the university experience is equally important: from academic activities to university operations [6].

Though SEE's role is increasingly acknowledged, integrating sustainable practices into the core role of higher education institutions remains a significant challenge [2]. Several complicated factors include student engagement, availability and budgetary resources, policy and governance structure, curricular integration, and institutional sustainability [7]. To ensure that SEE programs are successfully delivered, several key areas will need to be addressed. For curricular integration, an important factor is collaboration between disciplines and eliminating departmental boundaries. For universities to implement sustainability across disciplines, they need to develop common goals and strategies. Projects that include multiple disciplines from environmental sciences, social sciences, and humanities, or that integrate sustainability principles into introductory required courses, could achieve this goal [8]. This process may allow academic institutions to provide students with a comprehensive understanding of sustainability issues and the necessary skills to address them, as demonstrated in Figure 1. Sourcing and acquiring large financial and human resources continue to stifle the establishment and execution of SEE programs in various universities.

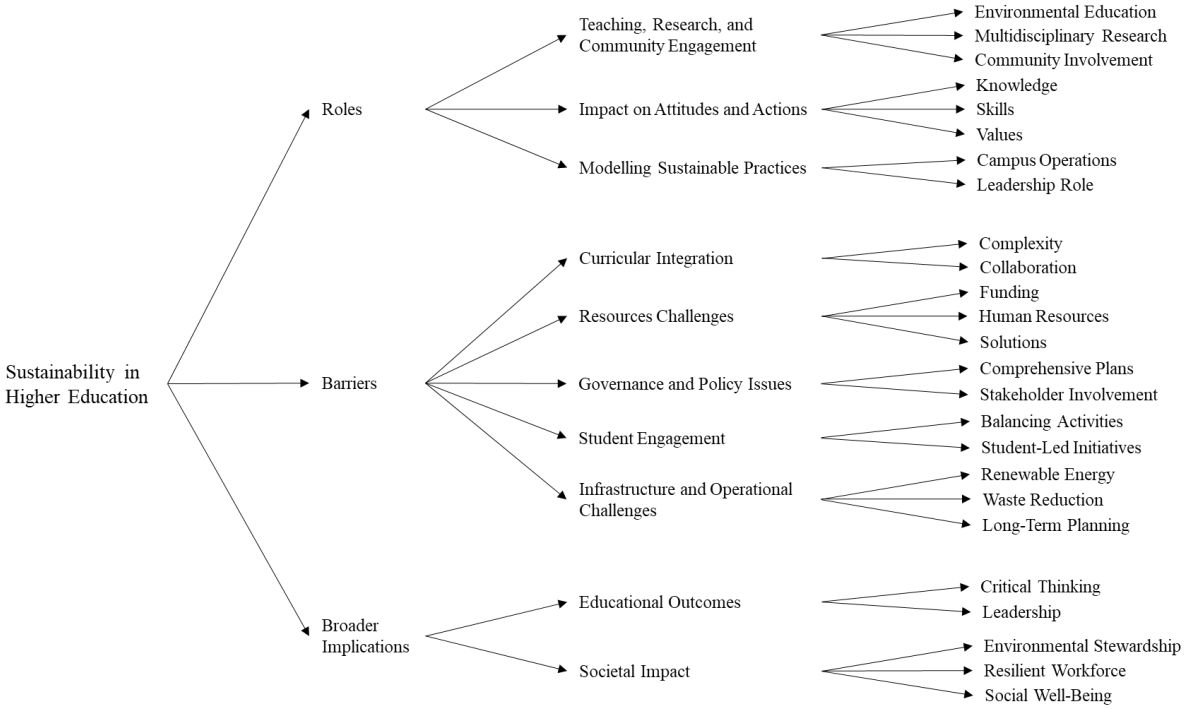

Figure 1: Taxonomy of Sustainability in Higher Education

Institutions could explore external funding opportunities through grants and collaborative projects with governments and business organizations to alleviate resource challenges. The approach applied by the University of Bristol in integrating sustainability into their courses shows the value of training and professional development programs for staff and helps build voluntary regulatory [9]. Sustainability initiatives must be integrated within the university's overall purpose and approach to governance for a holistic approach to governance and policy issues[10]. Reflexive governance and stakeholder engagement are critical for responding to amalgamated demands. Colleges and universities should implement sustainable practices in campus operations with sustainable procurement policies and work with local communities and businesses to diminish their institutional impact on the environment at the same time [11]. The purpose of this review paper is to provide a complete and detailed overview of the current state of sustainability education in higher education with a focus on barriers and possibilities for the

more successful implementation of sustainability education. This literature review paper will sum up the literature, find gaps and obstacles in the current literature, and offer possible ways to overcome such barriers. The study will contextualize the many areas in which sustainability could be undertaken in higher education while specifically addressing how important it is that sustainability education exists to educate the next generation of leaders and professionals to deal with vital environmental issues today. The evaluation of the literature will also extend to the broader implications for sustainability on institutional reputation, performance, and influence over space and time, along with rationalizing the need for a more holistic and integrated sustainable approach.

2. Literature Review

2.1. The Role of Higher Education in Sustainability

Higher education institutions can play a significant role in addressing international and global-scale environmental challenges through teaching, research, and community engagement [12]. Universities are positioned to impact people's attitudes and actions around environmental issues [13]. They argue that by bringing together environmental education through research, daily operations of campuses, and traditional academic courses, higher education can foster a sustainable culture. It is this tripartite of environmental integration that provides children with the knowledge, skills, and values to manage and mitigate the environmental issues they face. Multidisciplinary research and education are necessary to prepare students to address complex environmental issues [14]. Interdisciplinary approaches can foster the development of comprehensive solutions and a greater understanding of the complexity of environmental challenges [15].

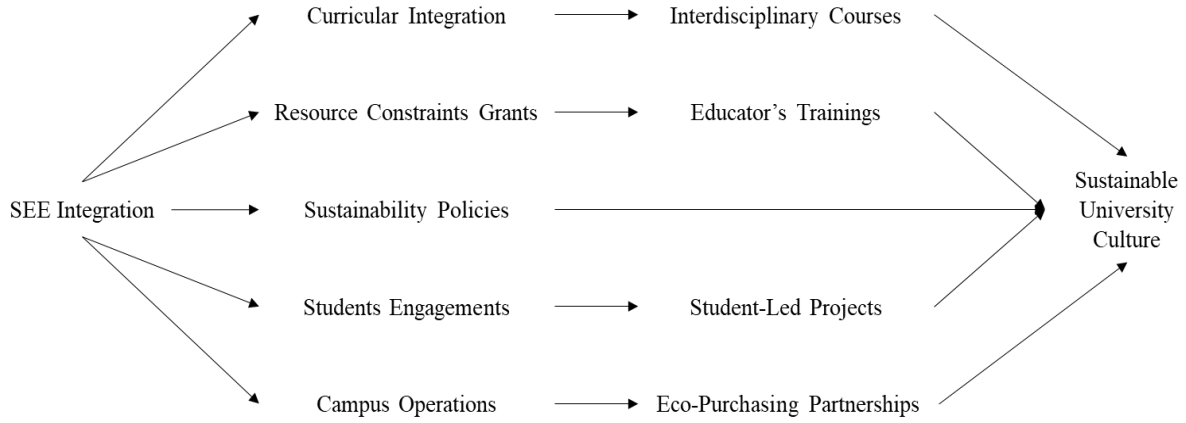

Figure 2: Pathways to Sustainable University Culture: Integrating SEE Across Campus Initiatives

Thus, universities can promote a deeper understanding of sustainability challenges as well as enhance creative approaches to moving forward through collaborations across disciplines. Higher education institutions can also model environmentally sustainable practices. Universities can demonstrate the feasibility and benefits of sustainable development through the incorporation of sustainable practices into their operations and by sharing with other businesses and communities. This leadership role is critical to building a culture of environmental stewardship and facilitating a more widespread adoption of sustainable practices [16] as demonstrated in Figure 2 and Table 1.

Table 1: Key Aspects of SEE in Higher Education

Aspect	**Description**	**Impact**
Teaching & Research	Educate via interdisciplinary study	Build skills for environmental solutions
Campus Operations	Model sustainable practices	Lead communities in green practices
Student Involvement	Foster student-led initiatives	Grow environmental awareness
Policy Integration	Embed sustainability in mission	Drive institutional change
Societal Influence	Shape public views on the environment	Promote a resilient and sustainable society

2.2. Barriers to the Implementation of SEE

The integration of sustainability is complex and varies from institution to institution. Barriers to sustainability integration arise at multiple levels and are not limited to curricular integration, limited fiscal resources, and the alignment of differing institutional policies. Curricular integration is complex in and of itself due to the autonomy of traditional academic disciplines that can limit a unified approach to bringing sustainability into a broad sense of diverse fields of study. Sterling and Thomas [4] acknowledge that developing multidisciplinary collaboration and resolving siloed departmental hierarchies presents significant challenges. Boarin and Martinez-Molina [17] suggest that universities develop all-encompassing SEE programs that facilitate sustainability across disciplines as they come together to create collective goals and frameworks to enable interdisciplinary collaboration. Resource challenges compounded by a lack of resources, including human resources and funding, are barriers to the implementation of SEE. Many institutions are unable to fund SEE projects sufficiently to prepare faculty, enrol students, and provide research opportunities for students [18]. Further, the shallow pool of trained faculty in the area of sustainability was also an issue.

Nonetheless, to work through these challenges, universities should align with external funding, including research grants and industry and government partnerships when possible; in addition, they should ensure existing faculty development is embraced through professional growth and training [19]. Policy and governance issues are central to universities to engage in meaningful and substantive change, as standardized governance structure resists changes towards sustainable practices and policies. Universities need to recognize sustainability in comprehensive plans and incorporate it into their mission and governance structures [20]. Involving all groups of stakeholders in the development and implementation of sustainability strategies will be beneficial as they can develop their governance structure through policies and initiatives to incorporate sustainability through students, staff, and faculty initiatives. Working together helps ensure the needs and preferences of all stakeholders are relevant to the sustainability initiative. Engaging students in sustainability initiatives is important for building a culture of environmental responsibility; however, balancing academic and extracurricular activities needs to be achieved [21]. The impact of student-led initiatives and campaigns is critical and supports the development of environmental awareness and action [22].

Universities should support student-led projects with resources such as finances, mentoring, and interaction. Sustainability can be included in extracurricular activities and student-led

initiatives by offering sustainability-oriented clubs, organizations, and activities. By allowing students opportunities to become engaged with sustainability initiatives outside the classroom, universities can facilitate student involvement and promote the development of an environmentally conscious culture. Deploying sustainable solutions within or in the operations and infrastructure of a university's facilities is a challenging and costly undertaking. It is difficult to make an impact on waste reduction initiatives, utilizing renewable energy sources, and integrating green-building standards [23]. Universities can utilize existing technologies, such as buildings designed to reduce energy usage via upgrades rather than retrofits for existing buildings, and/or develop a phased approach to creating sustainability for the institution. Long-term sustainability planning for sustainability-based operational and infrastructure goals may include sustainability-based goals for energy-use reduction, waste diversion rates, and renewables [18]. By implementing sustainability in their operations, universities can lead the way for other institutions and contribute to sustainable communities, as illustrated in Table 2.

Table 2: Challenges and Solutions in Implementing Sustainability in Higher Education

Aspect	Description	Challenges	Solutions	Outcomes
Curricular Integration	Integrating sustainability into the curriculum	Complexity due to academic discipline autonomy	Develop interdisciplinary programs, collective goals, and frameworks	Unified approach to sustainability education
Resource Challenges	Limited fiscal resources and trained faculty	Insufficient funding, shallow pool of trained faculty	Align with external funding, professional development, and training	Sufficient support for SEE projects
Policy and Governance	Resistance to change in standardized governance structures	Standardized governance resists sustainable practices	Recognize sustainability in comprehensive plans, and involve stakeholders	Meaningful and substantive change
Student Engagement	Balancing academic and extracurricular activities	Overwhelmed students	Support student-led projects, offer sustainability-oriented clubs	Enhanced student involvement
Operational and Infrastructure	Implementing sustainable solutions in university operations	Costly and challenging to implement	Use existing technologies, a phased approach, and long-term planning	Sustainable operations and infrastructure
Interdisciplinary Collaboration	Developing multidisciplinary collaboration	Siloed departmental hierarchies	Develop collective goals and frameworks	Comprehensive solutions
Stakeholder Involvement	Involving all stakeholders in sustainability strategies	Differing institutional policies	Develop policies and initiatives, and include students and staff	Relevance to sustainability initiatives
Student-Led Initiatives	Impact of student-led initiatives and campaigns	Balancing activities	Provide resources, mentoring, and interaction	Development of environmental awareness
Sustainability in Operations	Deploying sustainable solutions in university facilities	Challenging and costly	Utilize existing technologies, a phased approach	Leading by example, sustainable communities

2.3. Broader Implications

The challenges related to implementing SEE have broader consequences for service impact, institutional legitimacy, and educational effectiveness. SEE should improve student academic outcomes and support the promotion of students' critical and problem-solving skills [20]. By placing the emphasis on integrating sustainability within their degree program curriculum, universities may be preparing students to be better leaders and practitioners when it comes to addressing environmental topics. Colleges hold an essential role in shaping how society views environmental issues. Institutions of higher education, through examples of environmental stewardship and sustainability, can nurture a more resilient and sustainable society [4]. In addition, the effectiveness of SEE may be beneficial to society when colleges show a commitment to sustainability and being responsible stewards of the environment [24]. Colleges can set a standard for environmental conditions that may have benefits for many facets of society. By preparing students to grapple with environmental challenges, colleges can foster a workforce that is more resilient and sustainable. These improvements in sustainable practices may also increase social well-being, economic growth, and better environmental quality.

3. Discussion

3.1. Addressing Curricular Integration

In order to be effective in integrating SEE into the curriculum, a degree of curricular integration must be established concerning SEE, which may involve establishing a collaborative, multi-disciplinary approach and overcoming departmental, siloed practices wherever possible. Furthermore, universities should generate general frameworks and goals towards curricular integration in the way they consider the one embedded in projects, while they engage in SEE [25]. In addition, universities can enhance a student's understanding and adopt a more comprehensive view of sustainability through, for example, problem-based learning, project-based learning, and service learning [26]. The subject of curricular integration in higher education emerged as having international relevance for how graduates are prepared for the workforce. However, there is considerable recognition of curricular integration's purported advantages in the development of students' holistic learning. Barriers such as routines and institutional resistance, time factors, and financial capacity. While environmental challenges may require unique approaches due to regional variation, employers branded curricular integration as essential in their drive to improve graduates' employability skills [27]. Undergraduates appreciate curricular integration for its engagement and its application. Findings indicate that regional collaborations and targeted faculty development would improve curricular integration in order to enhance graduate employability. Table 3 outlines comprehensive strategies for SEE integration across key areas.

Table 3: Strategies for Sustainability in Environmental Education Integration Success

Strategy	Action	Outcome	Stakeholder Role	Scalability
Collaborative Curriculum	Blend disciplines via projects	Holistic student learning	Faculty lead, students contribute	High: Adaptable across disciplines
Resource Optimization	Tap grants, use OERs	Scalable SEE programs	Admin secures funds, student aid	Medium: Grant-dependent
Sustainable Governance	Align policies with SDGs	Transformative institutional change	Leadership drives, all engage	High: Policy-driven change

Student-Led Initiatives	Fund sustainability campaigns	Engaged, responsible students	Students lead, faculty mentor	Medium: Resource-intensive
Green Operations	Adopt eco-friendly practices	Reduced environmental impact	Facilities management, community ties	High: Phased implementation

3.2. Resource Constraints

Dealing with human and financial resources is an essential barrier to addressing SEE in the context of higher education, as illustrated in Figure 3. All universities struggle to find funding and trained faculty to implement SEE. Institutions can access funding through grants and partnerships with the government and the private sector to overcome these barriers. For example, Canada's Social Sciences and Humanities Research Council (SSHRC) offers funding for interdisciplinary sustainability projects to enable universities to support curriculum and research development [28]. Another form of partnership identified was with organizations like the David Suzuki Foundation, which could provide experience and co-funded programs aimed at developing campus sustainability programs to enhance community engagement [13]. The University of Bristol's framework is an example of innovative resource steering by embedding sustainability across its teaching programs, engaging both students and staff. This collaboration ensured consistency across their curriculum for sustainability, while fostering a culture of collaboration where 200 faculty had been trained in sustainability integration since 2020, which increased sustainability courses by 15% [29]. The University of Toronto's Sustainability Pathways program is another model of using students as volunteers to co-develop teaching materials, while decreasing the workload for faculty, and enhancing student engagement [30]. These types of stakeholder-enhanced collaboration initiatives show how institutions can reallocate their human resources without a significant additional cost. Websites like UNESCO's Open Educational Resources Commons allow faculty bots to access free sustainability modules in an editable form, and faculty to integrate SEE, without the burden of having to create anything new [31].

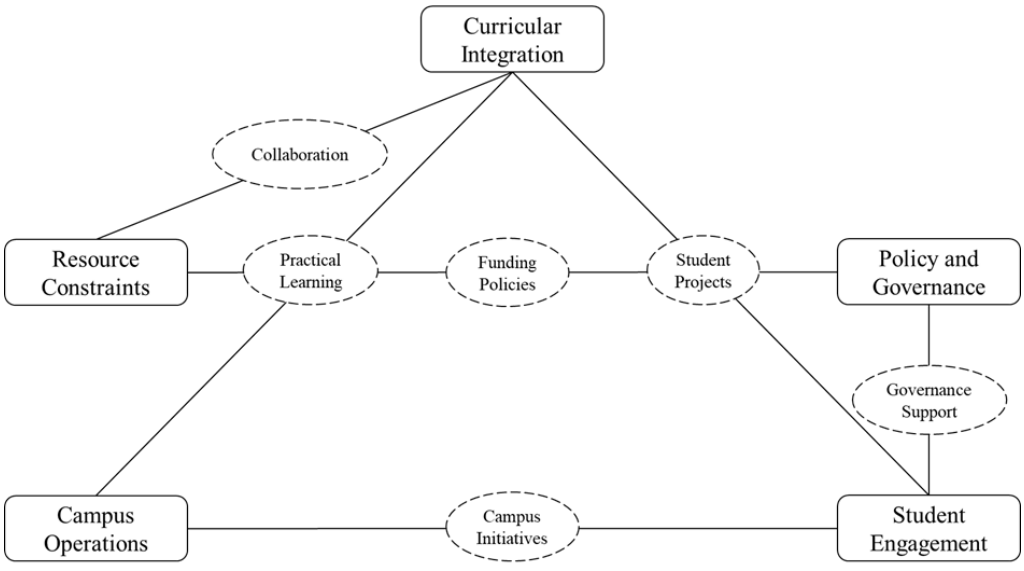

Figure 3: Sustainability and Environmental Education Integration Network in Higher Education

3.3. Alignment of Policy and Governance

An all-encompassing approach to align their institutional policies with sustainability priorities is required. Universities should have sustainability plans that support their natures, priorities, and systems of governance. All stakeholders should be involved in developing and implementing these plans [19]. Students, staff, faculty, and external collaborators contribute to this collaborative decision-making process. Reflexive governance, including feedback loops and continuous learning, is also necessary to respond to prevailing social and environmental pressures. An exploratory research development proposes a framework of criteria to assess how different sustainability frameworks may be used to support sustainability in higher education course units [32]. The criteria acknowledged the requirement for change that is both transformative and progressive, as well as the competing demands of a sustainable framework. The study examines three sustainability frameworks: a capitals approach, the three-pillar framework, and the Sustainable Development Goals (SDGs). Each framework has benefits and drawbacks, and the authors suggest that colleges select frameworks that suit their contextual needs.

3.4. Enhancing Student Engagement

An integrated approach is necessary to enhance student engagement with environmental initiatives. Colleges should provide resources and support for student-led initiatives and campaigns. Colleges should embed sustainability into student extracurricular activities and provide students with opportunities to engage in sustainability activities [33]. For instance, universities can provide a very active Student Sustainability Coalition that leads a variety of sustainability initiatives on campus. Colleges can also promote responsibility and ownership by providing leadership development programming and platforms for students to showcase their sustainability initiatives. More recently, literature notes the importance of sustainability and environmental education in teacher education research [34]. Although research in this area is increasing, there remain a number of gaps in the literature, especially about international research trends and methodology. The authors argued that universities should strive to create comprehensive teacher education programs emphasizing sustainable education practices to prepare future teachers better.

3.5. Implementing Sustainable Campus Operations

Campaigning sustainable practices in campus operations requires a significant amount of time and effort. Universities should create gradual action plans and use available technologies. Colleges/Universities should prioritize sustainable practices in any operation and infrastructure. Sustainable purchasing practices, such as using green cleaning products, energy-efficient devices, or other kinds of equipment, can greatly reduce a university's impact on the environment. Additionally, engaging with businesses and local communities to complete collaborative sustainability increases a university's impact and sustainability work. The authors' analytical framework for sustainable governance is based on five pillars, which include: the environment, policy issues, key issues and drivers, key strategies, and the policy cycle. These five pillars will facilitate future conceptual, comparative, and empirical work, in addition to assisting institutions in their sustainability work.

4. Recommendations and Conclusion

A plethora of obstacles to helping facilitate the adoption of SEE in higher education have been extensively reviewed in this paper. The implementation of SEE is an essential component of training the next generation of professionals and leaders in addressing the pressing environmental problems facing our world, going beyond a conventional scholarly approach. To address the barriers to strong SEE within the greater community, a comprehensive and collaborative strategy that engages all stakeholders, both in and outside of the university community, will be essential. To enact strong SEE programs, it will be imperative to ensure that sustainability education is embedded into various disciplinary contexts. In order to achieve this objective, it will be important to engage interdisciplinary collaboration, as departments traditionally work within silos. Collectively, universities should establish common goals and frameworks for SEE integration. Development of multidisciplinary courses, problem-and project-based learning, as well as service learning, could help achieve these objectives. Suppose the university sector is serious about building strong, educated citizens who can positively affect change. In that case, students must graduate with a mindful vision of sustainability issues and with the practical skills involved in addressing these problems.

One additional significant barrier facing institutions adopting SEE is addressing resource limitations. The lack of available funding or human capital can severely inhibit SEE institutions from developing or implementing SEE initiatives. Creative solutions can be considered by supporting industry and governments with their SEE efforts while seeking alternative funding sources from grants. The development of academic skills through professional development and training exercises is also a valuable opportunity to contribute to a supportive network of professional development in higher education institutions. The University's framework for sustainability in teaching and learning demonstrates how improving competence for teaching staff and assuring the engagement and relevance of students can include both teaching staff and students in the process. Academic institutions can leverage online tools and Open Educational Resources to enhance their sustainability initiatives with minimal financial resources. A significant yet essential obstacle is in embedding SEE, revamping institutional policies to align with sustainability objectives, and the importance of involving every stakeholder in the development and implementation of sustainability initiatives. Universities need to have a robust sustainability strategy aligned with broader institutional policies and governance. Universities need to be reflexive in their governance when changing to meet environmental and societal needs, with feedback loops and continuous learning built in. There are trade-offs for each model; therefore, academic institutions should choose the model that best meets their unique needs and contexts. An important initial step needed to reduce the environmental footprint of colleges is demonstrating sustainable approaches to all aspects of campus functioning. Colleges must recognize the importance of incorporating sustainable practices into their operations and infrastructure, thinking through the lens of sustainability first. Colleges and universities can develop joint sustainability programs with companies and municipalities and develop sustainable purchasing and procurement policies. The authors showed the need for organized strategies to advance research and policy development, presented a very useful model on sustainable governance, and provided a long-term response to sustainability issues.

In conclusion, there is a need for a comprehensive strategy to incorporate Sustainability and Environmental Education (SEE) into higher education that includes curriculum infusion, resourcing issues, alignment with policy, student involvement, and sustainable college

operations. With comprehensive SEE curricula and infusing sustainability into the curriculum relevant across subject areas, universities can engage students to develop a holistic understanding of sustainability. Additionally, creating innovative funding models and initiating staff development related to current resourcing challenges will ensure the longevity of advancing SEE. A coordinated approach to policies with sustainability aims, and the incorporation of all stakeholders in the process to create a friendly institutional approach. When students' interests are prioritized by supporting and encouraging student-led activities and leadership development initiatives, it results in increased participation that develops a sense of accountability. Implementing sustainable campus operations is an effective way to minimize environmental impact and to demonstrate, in practice, sustainability concepts in the real world. Future research should focus on the development of new methods and frameworks for the effective application of SEE, ensuring that academic institutions continue to demonstrate leadership in addressing environmental challenges across the globe. To address barriers to the implementation of SEE and to facilitate a more resilient and sustainable future overall, this assessment highlights the necessity of a collaborative and holistic engagement.

6. Competing Interests

Authors have declared that no competing interests exist.

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