

Developing Interdisciplinary Curriculum Models for Sustainability in Higher Education: A Focus on Critical Thinking and Problem Solving

David Iyanuoluwa Ajiga¹, Oladimeji Hamza², Adeoluwa Eweje³, Eseoghene Kokogho⁴, Princess Eloho Odio⁵

¹ Independent Researcher, Chicago, Illinois, USA

² Canadian Western Bank (CWB), Calgary, Canada

³ Canadian Western Bank, Calgary, Canada

⁴ Deloitte & Touche LLP, Dallas, TX, USA

⁵ Department of Marketing and Business Analytics, East Texas A&M University, Texas, USA

Corresponding author: davidarlingtonajiga@gmail.com

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Abstract

This paper explores the development of interdisciplinary curriculum models in higher education aimed at fostering sustainability by enhancing critical thinking and problem-solving skills. With global sustainability challenges demanding more comprehensive approaches, the integration of sustainability education across disciplines is essential. The paper discusses the theoretical foundations of interdisciplinary education, emphasizing its role in equipping students with the tools to address complex, real-world problems. It also outlines key strategies for integrating sustainability into the curriculum, including innovative pedagogical approaches and case studies of successful implementations. Additionally, the paper addresses the challenges associated with interdisciplinary curriculum development, such as institutional, financial, and cultural barriers, and highlights opportunities for inclusivity and faculty support. The conclusion offers recommendations for higher education institutions and identifies future directions for research and curriculum development to promote more effective and accessible sustainability education.

Keywords: *Interdisciplinary curriculum, Sustainability education, Critical thinking, Problem-solving skills, Higher education, Curriculum development*

1. Introduction

1.1 Overview of Sustainability in Higher Education

Sustainability has become a critical global concern as societies strive to balance economic development, environmental protection, and social equity. The higher education sector is pivotal in promoting sustainability by equipping future leaders with the knowledge, skills, and attitudes needed to address complex global challenges. As the world grapples with issues such as climate change, resource depletion, and social inequity, universities and colleges are increasingly integrating sustainability principles into their teaching, research, and operational practices (Hariram, Mekha, Suganthan, & Sudhakar, 2023).

In recent years, many higher education institutions have embraced sustainability not only in their campus operations but also within their academic programs. This shift reflects a growing recognition that sustainable development requires more than technical solutions—it necessitates a deep understanding of the social, environmental, and economic dimensions of problems and the ability to work across disciplines (Ruiz-Mallén & Heras, 2020). Institutions are evolving from viewing sustainability as a peripheral issue to embedding it into the core of their educational mission. Sustainability education in higher learning thus aims to produce graduates who are knowledgeable and equipped with the skills to act as change agents in their professional and personal lives (Menon & Suresh, 2020).

1.2 The Need for Interdisciplinary Curriculum Models

Traditional education systems often compartmentalize knowledge into distinct disciplines, limiting students' ability to understand and solve real-world problems, which are inherently complex and interdisciplinary. The challenges posed by sustainability, such as reducing carbon emissions, managing natural resources, and fostering social justice, require an integrated approach that draws upon knowledge from diverse fields such as environmental science, economics, social sciences, engineering, and the humanities. In this context, interdisciplinary curriculum models are essential for fostering a comprehensive understanding of sustainability (George, 2023).

Interdisciplinary education encourages students to break down silos between subjects, fostering a more holistic and integrative way of thinking. This approach is crucial for sustainability, which demands a balance between different—sometimes conflicting—interests and perspectives. For instance, tackling climate change involves technical solutions from engineering and science and insights from economics, politics, and ethics. By combining these perspectives, interdisciplinary education prepares students to approach sustainability challenges with the intellectual flexibility required to devise innovative solutions (Tariq, 2024). Moreover, interdisciplinary curriculum models respond to the increasing demand for graduates who are not only subject-matter experts but also critical thinkers and problem solvers capable of synthesizing information from various fields. Such curricula empower students to understand the interconnections between human and natural systems, thereby enabling them to craft solutions that are sustainable in the long term (Chang et al., 2022).

1.3 Importance of Critical Thinking and Problem-Solving for Sustainability Challenges

Incorporating critical thinking and problem-solving skills into sustainability education is fundamental to developing future leaders who can navigate complex global challenges. Critical thinking allows students to evaluate assumptions, evidence, and arguments systematically and independently. This skill is essential when addressing sustainability, as many issues, such as the use of fossil fuels or agricultural practices, are deeply embedded in social, economic, and political systems. Students must be able to question established practices and propose innovative solutions that promote sustainability without undermining social or economic progress.

Problem-solving, on the other hand, involves the application of critical thinking to real-world scenarios. It requires identifying a problem and understanding its root causes, exploring potential solutions, and implementing strategies that can have a lasting positive impact. In sustainability, problem-solving often involves navigating trade-offs between environmental

protection, economic growth, and social equity. For example, the transition to renewable energy sources must consider the economic implications for communities reliant on fossil fuels, the environmental benefits of reducing carbon emissions, and the social justice aspect of ensuring that vulnerable populations have access to clean energy (Desha, Caldera, & Hutchinson, 2021).

By fostering critical thinking and problem-solving skills, interdisciplinary curriculum models in sustainability education prepare students to become effective decision-makers who can approach problems from multiple angles. This, in turn, enables them to address the pressing challenges of our time—such as climate change, biodiversity loss, and inequality—in innovative and practical ways. These skills are crucial for environmental professionals and all graduates, as sustainability has become a central concern across industries and sectors (Animashaun, Familoni, & Onyebuchi, 2024b; Atobatele, Kpodo, & Eke, 2024).

1.4 Objectives and Scope of the Paper

This paper aims to explore the development of interdisciplinary curriculum models that integrate sustainability into higher education, with a focus on fostering critical thinking and problem-solving skills. The paper argues that traditional, discipline-specific education models are insufficient for addressing sustainability's complex and interconnected challenges. Instead, interdisciplinary approaches are needed to equip students with the holistic understanding and flexible thinking required to tackle global sustainability issues. The primary objective is to examine how these curriculum models can enhance the ability of students to think critically and solve sustainability-related problems.

Additionally, the paper will address how interdisciplinary models can be adapted to meet the needs of diverse student populations, including those from underserved backgrounds. Inclusivity in sustainability education is paramount, as sustainability challenges disproportionately affect marginalized communities, and their perspectives are essential for creating equitable solutions. By considering the diverse needs of students, interdisciplinary curriculum models can enhance educational outcomes and contribute to more just and inclusive sustainability practices.

The scope of this paper includes an analysis of existing interdisciplinary curriculum models in higher education, strategies for integrating sustainability into these models, and the challenges and opportunities associated with their implementation. The paper will also explore the role of faculty, institutional support, and pedagogy in creating effective interdisciplinary sustainability curricula. Through this investigation, the paper offers recommendations for higher education institutions seeking to integrate sustainability into their academic programs in a way that fosters critical thinking, problem-solving, and inclusivity.

2. Theoretical Foundations of Interdisciplinary Curriculum Models

2.1 Definition and Principles of Interdisciplinary Education

Interdisciplinary education refers to a pedagogical approach that integrates concepts, theories, and methodologies from multiple academic disciplines to address complex questions or problems. This approach transcends traditional academic boundaries, allowing students to gain a more holistic and comprehensive understanding of issues that are often too multifaceted to

adequately address by a single discipline. In the context of higher education, interdisciplinary learning fosters intellectual flexibility, encouraging students to synthesize knowledge from diverse fields and apply it to real-world situations (Morel & Spector, 2022).

The principles of interdisciplinary education are rooted in collaboration and integration. Collaboration among academic departments and students from different backgrounds promotes diverse perspectives and fosters innovative problem-solving. Integration, on the other hand, involves weaving together concepts and approaches from different fields to create a cohesive learning experience. Students engaged in interdisciplinary education are trained to think critically, explore connections, and approach problems with a systems-based perspective. For instance, a course on climate change might incorporate elements from environmental science, economics, social justice, and political theory, enabling students to understand the complex interplay between natural systems and human societies (Christensen, Ekelund, Melin, & Widén, 2021).

Another key principle of interdisciplinary education is contextual learning, which encourages students to situate knowledge within broader social, cultural, and historical contexts. This allows students to see how different disciplines inform each other and how a comprehensive understanding of a problem often requires input from multiple areas of expertise. For example, understanding sustainable development requires technical knowledge about renewable energy and insights from economics, sociology, and public policy to ensure equitable and feasible solutions (Van den Beemt et al., 2020).

2.2 The Role of Sustainability in Curriculum Design

Sustainability has become a central theme in higher education curriculum design due to the pressing need for solutions to global challenges such as climate change, biodiversity loss, and resource depletion. Sustainability education equips students with the skills and knowledge required to promote environmental stewardship, social equity, and economic viability. Integrating sustainability into the curriculum goes beyond simply adding environmental science courses—it requires rethinking educational approaches to embed sustainability principles across all disciplines and learning experiences (Glavič, 2020).

In curriculum design, sustainability is often framed around three interconnected pillars: environmental, social, and economic. These pillars reflect the need for balance in addressing ecological health, social well-being, and economic development. Curriculum models that integrate sustainability principles aim to help students develop an understanding of these interconnected pillars, fostering the ability to approach sustainability challenges with a holistic mindset (Molthan-Hill, Blaj-Ward, Mbah, & Ledley, 2022).

For sustainability to be effectively incorporated into curriculum design, it must be interdisciplinary. Environmental problems, such as climate change or deforestation, are not isolated from social and economic systems, making it essential for students to understand how these systems interact. Interdisciplinary education offers a means of addressing sustainability challenges by incorporating diverse fields such as environmental science, political science, economics, and ethics into a unified framework. This allows students to see the interconnectedness of human and natural systems and to develop solutions that account for the complexities of real-world sustainability challenges (Shrivastava, Smith, O'Brien, & Zsolnai, 2020).

2.3 Existing Models in Higher Education and Their Limitations

Several interdisciplinary models for sustainability education have been implemented in higher education institutions, with varying degrees of success. One popular approach is the development of interdisciplinary degree programs focused on sustainability. These programs often combine courses from different departments—such as biology, economics, and sociology—to provide students with a broad understanding of sustainability issues. While these programs are valuable for promoting interdisciplinary learning, they often face challenges regarding faculty collaboration, course integration, and institutional support (Figueiró, Neutzling, & Lessa, 2022).

Another model involves creating sustainability-focused courses or modules within traditional degree programs. For instance, engineering students might be required to take courses on sustainable design, while business students might study corporate social responsibility. This approach has the advantage of integrating sustainability into a wide range of disciplines, making it accessible to students who may not be majoring in environmental fields. However, this model can be limited because these courses are often elective, meaning that not all students engage with sustainability content (Micklethwaite, 2022).

One significant limitation of existing models is the challenge of fostering deep interdisciplinary collaboration among faculty members. Many academic departments operate independently, with little incentive for cross-disciplinary teaching or research. This can result in siloed learning experiences, where students are exposed to sustainability concepts in isolated courses but are not given the opportunity to integrate knowledge across disciplines. Additionally, faculty may lack the training or resources needed to effectively teach interdisciplinary courses, which can hinder the development of cohesive sustainability curricula (Doukanari, Ktoridou, Efthymiou, & Epaminonda, 2021).

Another limitation is that interdisciplinary programs can sometimes be too broad, leading to superficial coverage of topics. Students may be introduced to sustainability from a variety of perspectives but may not gain the depth of understanding needed to address complex sustainability challenges. Balancing breadth and depth in interdisciplinary education is a key challenge that must be addressed in the development of effective curriculum models (Gosselin, Thompson, Pennington, & Vincent, 2020).

2.4 Importance of Sustainability, Critical Thinking, and Problem-Solving in Higher Education

The integration of sustainability with critical thinking and problem-solving skills is crucial for preparing students to address the global challenges of the 21st century. Sustainability issues are inherently complex, requiring individuals who can think critically about the causes and consequences of environmental, social, and economic problems. By embedding sustainability into interdisciplinary education, higher education institutions can cultivate a new generation of problem solvers who are equipped to tackle these challenges from multiple perspectives (Latilo, Uzougbo, MC, & Oduro, 2024).

Critical thinking involves analyzing information, questioning assumptions, and evaluating arguments, all of which are essential for understanding sustainability. For instance, students studying the transition to renewable energy must be able to critically assess the benefits and

drawbacks of various technologies and the social and economic implications of energy policy decisions. This requires technical knowledge and the ability to think critically about the broader context in which sustainability decisions are made (Amin, Utaya, Bachri, Sumarmi, & Susilo, 2020).

Problem-solving, meanwhile, involves applying knowledge and critical thinking to develop solutions to real-world problems. Sustainability challenges often require innovative and creative solutions and the ability to navigate trade-offs between competing interests. For example, designing sustainable cities requires balancing the needs for economic growth, social equity, and environmental protection. An interdisciplinary approach to sustainability education fosters the problem-solving skills needed to address these complex issues by exposing students to diverse perspectives and encouraging them to think creatively about integrating different fields of knowledge (Heard, Scoular, Duckworth, Ramalingam, & Teo, 2020).

Incorporating sustainability, critical thinking, and problem-solving into higher education is essential for producing knowledgeable graduates who can positively impact their communities and professions. These skills are transferable across various disciplines and career paths, making them valuable for all students, regardless of their major. By integrating sustainability education into interdisciplinary curriculum models, higher education institutions can prepare students to become leaders and innovators in the effort to create a more sustainable and equitable world (Thomassen & Stentoft, 2020).

3. Strategies for Integrating Sustainability into Interdisciplinary Curriculum

3.1 Curriculum Design

Integrating sustainability into interdisciplinary curriculum models requires a thoughtful approach to curriculum design that emphasizes critical thinking. The goal is to teach students about sustainability and cultivate their ability to think critically about complex, interconnected issues that span environmental, social, and economic domains. Curriculum design must, therefore, prioritize inquiry-based learning, where students are encouraged to question assumptions, evaluate evidence, and consider multiple perspectives (Christensen et al., 2021). One effective strategy for fostering critical thinking is the inclusion of problem-based learning (PBL). In this approach, students are presented with real-world sustainability challenges and are tasked with developing potential solutions. PBL shifts the focus from passive absorption of information to active problem-solving, requiring students to engage deeply with the subject matter. For instance, a course on water resource management might ask students to address water scarcity in a specific region, integrating knowledge from environmental science, economics, and social justice (Heystek, 2021).

Another design approach that fosters critical thinking is the incorporation of systems thinking into the curriculum. Systems thinking encourages students to view sustainability issues as part of larger, interconnected systems, where changes in one part of the system can have ripple effects across others. This holistic perspective is crucial for understanding the complexities of sustainability challenges. For example, in studying climate change, students might explore how environmental policies influence economic activities, which in turn impact social inequality. The curriculum emphasizes systems thinking and helps students move beyond linear cause-and-effect reasoning and develop a more nuanced understanding of sustainability (Manna, Rombach, Dean, & Rennie, 2022).

Curriculum design can also benefit from cross-disciplinary collaboration among faculty members. Courses co-taught by professors from different academic backgrounds allow students to see firsthand how various disciplines contribute to understanding sustainability challenges. This collaborative approach exposes students to diverse viewpoints, helping them critically evaluate the strengths and limitations of different disciplinary approaches. For example, a course on sustainable agriculture might be co-taught by biology, economics, and sociology faculty, offering students a more comprehensive view of food systems (Plank, 2023).

3.2 Pedagogical Methods to Enhance Problem-Solving Skills

Adopting pedagogical methods that enhance students' problem-solving abilities is essential to effectively integrate sustainability into interdisciplinary curricula. These methods should emphasize active learning, collaboration, and real-world application, equipping students with the skills necessary to tackle sustainability challenges in their future careers (Elsayary & Baroudi, 2023). One such method is experiential learning, where students participate in hands-on, practical experiences that allow them to apply theoretical knowledge to real-world situations. For example, students might engage in sustainability projects such as developing community gardens, conducting energy audits, or designing sustainable buildings. These activities reinforce classroom learning and help students develop critical problem-solving skills as they navigate the complexities of implementing sustainability solutions in practice (Singha & Singha, 2024).

Collaborative learning is another pedagogical approach that enhances problem-solving skills. By working in teams, students are exposed to diverse perspectives and are required to negotiate and integrate different viewpoints in order to arrive at solutions. This mirrors the real-world context in which sustainability challenges are addressed through collaboration among scientists, policymakers, businesses, and communities. For instance, in a course on renewable energy, students could work in groups to design a comprehensive energy plan for a city, considering technical, economic, and social factors. Through this process, they learn to balance competing interests and constraints—an essential skill in sustainability problem-solving (Akintayo, Eden, Ayeni, & Onyebuchi, 2024b).

Pedagogical methods such as design thinking can also play a role in enhancing problem-solving skills. Design thinking is a human-centered approach to innovation that emphasizes empathy, creativity, and iterative testing. In sustainability education, design thinking encourages students to approach problems from the perspective of the people or communities affected by sustainability challenges. For example, students might design solutions to reduce waste in urban areas by first understanding the behaviors, needs, and challenges of local residents and businesses. This focus on empathy and iterative testing helps students develop creative and practical solutions that are grounded in real-world contexts (Taşpınar, 2022).

3.3 Case Studies or Examples of Successful Implementations

Several higher education institutions have successfully integrated sustainability into interdisciplinary curricula, serving as models for others. One notable example is the University of British Columbia (UBC), which has implemented a sustainability-focused curriculum that spans multiple disciplines. UBC offers an interdisciplinary degree in sustainability, with courses designed to address global challenges such as climate change, food security, and energy transitions. Through a combination of lectures, labs, and fieldwork, students engage with

sustainability from environmental, social, and economic perspectives, developing critical thinking and problem-solving skills along the way (Bergstrom & Lovejoy, 2023).

Another successful implementation can be found at Arizona State University (ASU), where the School of Sustainability offers interdisciplinary programs that emphasize experiential learning and real-world problem-solving (Hakkarainen et al., 2024). ASU's sustainability curriculum integrates natural sciences, social sciences, engineering, and humanities knowledge, enabling students to tackle complex sustainability issues. The school also partners with local governments and businesses, allowing students to work on sustainability projects that directly impact the community. This real-world engagement not only reinforces academic learning but also prepares students for careers in sustainability (Konrad, Wiek, & Barth, 2021).

Similarly, the University of Vermont (UVM) has developed a Sustainability Learning Outcomes program that integrates sustainability into all undergraduate courses. The program emphasizes systems thinking, critical analysis, and problem-solving, to prepare students to address sustainability challenges in any field of study. UVM's approach highlights the importance of embedding sustainability across the curriculum, rather than confining it to specific disciplines or degree programs (Hudspeth, 2020).

3.4 Adapting the Curriculum to Suit Diverse Student Populations

One of the key challenges in developing interdisciplinary sustainability curricula is ensuring that the curriculum is inclusive and accessible to diverse student populations, particularly those from underserved backgrounds. This requires intentionally focusing on equity, diversity, and inclusion in curriculum design and delivery. To make sustainability education more accessible, institutions must recognize the unique experiences and perspectives that underserved students bring to the classroom. Incorporating these perspectives into the curriculum can enrich the learning experience for all students, while also making the content more relevant and engaging for diverse learners. For example, courses on environmental justice can highlight the disproportionate impact of environmental degradation on marginalized communities, helping students understand how sustainability issues intersect with social equity. By addressing these intersections, the curriculum can empower underserved students to see themselves as agents of change in the sustainability movement (Kumi-Yeboah, Kim, Sallar, & Kiramba, 2020).

Adapting the curriculum to diverse student populations also involves providing flexible learning pathways that accommodate different learning styles and life circumstances. This might include offering online or hybrid courses, making sustainability education more accessible to working students or those with caregiving responsibilities. Additionally, interdisciplinary curricula should be designed to allow for multiple entry points, enabling students from various academic backgrounds to engage with sustainability content, regardless of their prior knowledge or experience (Valtonen et al., 2021).

Mentorship and support services are critical for helping underserved students succeed in interdisciplinary sustainability programs. Faculty and advisors can be key in providing guidance and encouragement, particularly for first-generation college students or those from underrepresented groups. Creating a supportive learning environment that values diversity and fosters inclusion can help ensure that all students have the opportunity to develop the critical thinking and problem-solving skills needed to address sustainability challenges (Denham, Rozance, Malone, & Goodling, 2021).

4. Challenges and Opportunities

4.1 Barriers to Integration in Higher Education

Implementing an interdisciplinary sustainability curriculum in higher education is fraught with several barriers, spanning institutional, financial, and cultural challenges. These barriers can slow or complicate the integration of sustainability across multiple disciplines and hinder the development of curricula that foster critical thinking and problem-solving. One of the primary institutional barriers is the traditional structure of academic departments, which often operate in silos. Most higher education institutions are organized by discipline, making it difficult for faculty from different departments to collaborate on interdisciplinary courses (Armellini, Teixeira Antunes, & Howe, 2021). This siloed structure creates challenges in aligning curricula, setting shared objectives, and ensuring the flow of knowledge across disciplines. For example, a course on sustainability might require inputs from environmental science, economics, and sociology, but the rigid departmental boundaries can make it difficult to coordinate such an interdisciplinary effort. Furthermore, academic departments may have conflicting priorities and resource allocations, which complicates the implementation of interdisciplinary courses (Naujokaitienė, Tamoliūnė, Volungevičienė, & Duart, 2020).

Financial constraints are another significant challenge. Developing and maintaining interdisciplinary sustainability programs can be expensive, requiring investments in faculty training, curriculum development, and resources such as labs or field experiences. Many universities operate under tight budgets, making it difficult to allocate sufficient funds to develop new programs. Additionally, securing external funding for interdisciplinary programs can be challenging, as research grants and funding bodies often prefer projects that fit neatly within traditional disciplinary boundaries (Akintayo, Eden, Ayeni, & Onyebuchi, 2024a; Ewim, 2023).

Cultural barriers also play a role in hindering the integration of sustainability into the curriculum. Faculty members and academic leaders may resist change due to long-standing academic traditions and norms. In many institutions, interdisciplinary approaches are seen as secondary to discipline-specific expertise. This cultural inertia can make it difficult to gain buy-in from faculty and administrators, which is essential for the successful implementation of new curricula. Moreover, some faculty members may lack the necessary knowledge or training to effectively teach sustainability topics, further limiting the integration of interdisciplinary models (Armellini et al., 2021).

4.2 Opportunities for Enhancing Inclusivity in Curriculum Models

Despite the challenges, numerous opportunities exist to enhance inclusivity within interdisciplinary sustainability curriculum models. These opportunities lie in the potential to create learning environments that reflect the student population's diverse needs, experiences, and backgrounds. Sustainability education can serve as a platform for promoting equity, diversity, and inclusion, ensuring that students from all walks of life can access knowledge and skills relevant to addressing global sustainability challenges.

One key opportunity is the incorporation of diverse cultural perspectives into sustainability curricula. By including content that reflects the experiences and knowledge systems of different communities, particularly those that are often marginalized or underrepresented, educators can

create more inclusive and engaging learning experiences. For example, Indigenous knowledge systems offer valuable insights into sustainable land management, conservation, and resource use. Integrating these perspectives into the curriculum enriches the content and ensures that students from Indigenous backgrounds see their cultural heritage reflected in their education.

Another opportunity lies in the use of flexible learning pathways, which can make interdisciplinary sustainability programs more accessible to diverse student populations. For instance, offering online or hybrid courses allows non-traditional students, such as working professionals or students with caregiving responsibilities, to participate in sustainability education. Similarly, developing modular programs that allow students to tailor their learning experience to their specific interests and career goals can help ensure that the curriculum is relevant and accessible to students from a variety of academic and professional backgrounds (Olanike, Asogwa, Njideka, Daniel, & Temiloluwa, 2023).

Interdisciplinary sustainability curricula can also serve as a vehicle for social justice education. By highlighting the intersections between environmental sustainability and social equity, these programs can help students understand how issues such as climate change, resource depletion, and pollution disproportionately affect marginalized communities. In doing so, the curriculum promotes sustainability and fosters a deeper understanding of social justice, empowering students to become advocates for change in both environmental and social spheres.

4.3 The Role of Faculty Training and Institutional Support

The successful implementation of an interdisciplinary sustainability curriculum depends heavily on faculty training and institutional support. Faculty members are the linchpins of curriculum development and delivery, and their ability to effectively teach interdisciplinary content is crucial. However, many faculty members may not have been trained in interdisciplinary approaches or sustainability topics, which can limit their effectiveness in delivering these courses.

To address this, institutions must invest in faculty development programs that provide educators with the knowledge, skills, and resources they need to teach interdisciplinary sustainability courses. This training should focus not only on the content of sustainability but also on innovative pedagogical methods that foster critical thinking and problem-solving. For example, faculty members could be trained in systems thinking, problem-based learning, and experiential learning techniques, all of which are essential for effective sustainability education. Workshops, seminars, and collaborative teaching initiatives can also help faculty members develop interdisciplinary approaches and encourage cross-departmental collaboration.

Institutional support is equally important. Universities must create an environment encouraging interdisciplinary collaboration and innovation in curriculum design. This might include providing financial support for interdisciplinary initiatives, such as seed funding for course development or research grants that encourage faculty collaboration across disciplines. Additionally, institutions can support interdisciplinary education by recognizing and rewarding faculty members who engage in innovative teaching practices. Promotion and tenure criteria, for example, could be revised to give greater weight to interdisciplinary teaching and research, encouraging more faculty members to embrace these approaches.

Strong leadership from university administrators is also crucial. Academic leaders must champion interdisciplinary sustainability education and work to create policies that facilitate collaboration across departments. This could include establishing interdisciplinary centers or institutes dedicated to sustainability, which can serve as hubs for research, teaching, and community engagement. Such initiatives provide a focal point for sustainability education and signal the institution's commitment to addressing global sustainability challenges.

4.4 Addressing Diverse Learning Needs and Backgrounds

A key consideration in the development of interdisciplinary sustainability curricula is the need to address students' diverse learning needs and backgrounds. Higher education institutions serve a wide range of learners, including students from different cultural, socioeconomic, and academic backgrounds. Ensuring that interdisciplinary curricula are inclusive and accessible to all students is critical to their success.

One strategy for addressing diverse learning needs is differentiated instruction, tailoring teaching methods and materials to accommodate students' abilities and learning styles. For example, some students may learn best through hands-on, experiential activities, while others may prefer theoretical or text-based learning. By incorporating various instructional methods—such as group work, individual research projects, case studies, and fieldwork—educators can ensure that all students can engage with the material in ways that suit their learning preferences.

It is also important to recognize and address the different levels of prior knowledge that students bring to interdisciplinary sustainability courses. Some students may have a strong background in environmental science, while others may be more familiar with social or economic aspects of sustainability. To ensure that all students can succeed, educators should provide scaffolded learning experiences that gradually build students' knowledge and skills. This might include introductory modules providing foundational knowledge in key areas and more advanced, interdisciplinary content integrating these concepts.

Finally, creating a supportive and inclusive classroom environment fosters student engagement and success. Educators should strive to create a learning atmosphere that values diversity and encourages all students to contribute their perspectives. This can be achieved through the use of inclusive teaching practices, such as actively seeking input from all students, using culturally responsive materials, and addressing issues of power and privilege in discussions of sustainability. By fostering an inclusive classroom environment, educators can help ensure that all students feel valued and empowered to engage with sustainability issues (Animashaun, Familoni, & Onyebuchi, 2024a).

5. Conclusion and Recommendations

5.1 Conclusion

Exploring interdisciplinary curriculum models for sustainability in higher education reveals significant challenges and transformative potential. The integration of sustainability education requires breaking down traditional academic silos, fostering collaboration across disciplines, and emphasizing critical thinking and problem-solving skills. Interdisciplinary approaches are key in addressing global sustainability challenges, as they encourage students to view problems

holistically, combining insights from various fields such as environmental science, economics, sociology, and technology.

The analysis also highlights the necessity of overcoming institutional, financial, and cultural barriers to fully implement these curricula. Many universities still operate within rigid disciplinary structures, and financial constraints often limit the development of interdisciplinary programs. Additionally, cultural resistance to change and faculty training in interdisciplinary teaching methods hinder progress. However, there are also significant opportunities to enhance inclusivity in curriculum models by incorporating diverse perspectives, flexible learning pathways, and social justice education, thereby making sustainability education accessible to a broader range of students, including those from underserved backgrounds.

5.2 Recommendations for Higher Education Institutions

For higher education institutions, the successful implementation of interdisciplinary sustainability curricula demands comprehensive institutional support, including faculty training, policy reforms, and financial investment. Universities should prioritize the development of interdisciplinary programs by encouraging collaboration between departments and providing resources for course development. This can be achieved by establishing interdisciplinary centers or sustainability institutes that foster collaboration among faculty members from different disciplines.

Additionally, institutions should invest in ongoing faculty development, providing educators with the tools and training to effectively teach sustainability topics and interdisciplinary content. Workshops, seminars, and cross-departmental collaborations should be promoted to ensure faculty are well-equipped to deliver courses that emphasize critical thinking and problem-solving.

To overcome financial constraints, universities should seek external funding opportunities, such as grants from governmental or non-governmental organizations that support sustainability education. Partnering with industries or environmental organizations that have an interest in sustainability could also provide funding, resources, and real-world case studies that enrich the curriculum.

Inclusive curriculum design is also critical. Higher education institutions must ensure that sustainability education is accessible to students from diverse backgrounds. This can be done by integrating content that reflects the experiences and knowledge of marginalized communities, such as Indigenous knowledge systems, and offering flexible learning options, such as online courses or hybrid learning environments. These strategies will make sustainability education more accessible to working students, non-traditional learners, and those from underserved communities.

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