

The Role of Curriculum Design in Supporting Sustainability Education: A Global Perspective

DOI: 10.5281/zenodo.14868998

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Abstract

The study investigates educational curricula development to support sustainability teaching across global systems. The rising need to resolve environmental issues and social challenges makes adopting sustainability education principles into formal curriculum programs an urgent necessity. The research evaluates sustainability education adopted by multiple nations in their national curriculum frameworks but emphasizes the success of curriculum design to achieve sustainable development goals (SDGs) regionally along with the national and world stages. This study evaluates multiple educational frameworks through content comparisons to determine top-level strategies that successfully integrate sustainability lessons. This investigation also examines the education challenges that include limited resources together with shortages of experienced personnel while competing instructional targets stand as barriers to delivering sustainability-focused courses. The authors analyzed data from four groups of respondents beginning with educational policymakers followed by curriculum designers then teachers and ending with students in Europe, North America, and Asia. The analysis looks at how global education programs such as UNESCO's Education for Sustainable Development (ESD) shape curriculum development. Research shows that creating effective sustainability education requires integrated teaching approaches combined with local and global content integration and critical thinking instruction. The exploration adds to ongoing studies about using curriculum design as a sustainability achievement method while training students who can face modern global challenges. The research provides recommendations for improving methodologies that create curricula to enhance sustainability learning nationwide.

Keywords: Curriculum Design, Sustainability Education, Sustainable Development Goals (SDGs), Interdisciplinary Learning, Education for Sustainable Development (ESD)

Introduction

Current global education focuses on sustainability because environmental and social challenges keep intensifying. Curriculum design functions as a fundamental element that determines what students learn which enables its essential role in developing sustainability education programs. The primary goal of sustainability education goes further than environmental knowledge instruction because it aims to develop responsible citizenship along with effective decision-making capabilities. Future generations acquire the necessary skills to confront global challenges including climate change and poverty and inequality by including sustainability principles across educational curricula.

A global investigation of curriculum design practices supporting sustainability education evaluates how entire countries integrate sustainability topics into their national teaching standards. Through analyzing how curriculum contents relate to educational methods with sustainable development principles, this investigation aims to identify proven effective practices that boost sustainability education in modern educational environments. The research analyzes the obstacles faced by teaching professionals who teach sustainable education as well as suggestions for improving curriculum to back the United Nations' Sustainable Development Goals (SDGs). This research assumes a comparative framework by studying numerous educational systems in Europe North America and Asia to note standard elements and distinct features in curriculum design. The primary objective of this research project is to contribute to sustainability education discussions and generate findings that will guide worldwide curriculum development strategies.

Literature Review

The global educational landscape now prioritizes sustainability education through curriculum integration because school systems realize 21st-century students need this expertise to manage environmental social and economic challenges. Educational sustainability integrates understanding of environmental issues with social equality and economic stability according to the United Nations Sustainable Development Goals (SDGs). Educational sustainability

depends heavily on purposeful curriculum development because curricula shape how sustainability subjects are taught in learning environments.

Literature shows sustainability education should shift its focus from traditional environmental science to embrace sustainability concepts throughout disciplinary contexts while promoting interdisciplinary collaboration. The authors Barth and Michael (2018) note that sustainability education needs to be deeply integrated into curriculum content across science, economics, and social studies while encouraging students' understanding of environmental-human system connections. Through this comprehensive method, students learn the essential analytical abilities required to solve intricate sustainability challenges.

Multiple research projects stress how experiential learning stands essential for sustainability education due to student participation in solving practical sustainability challenges. According to Sterling (2017) schools should teach students through community-based projects combined with environmental audits and global partnerships to better understand sustainability in practice.

Teaching strategies alongside curriculum content function as essential components for delivering sustainability education. Research conducted by Tilbury and Wortman (2019) demonstrates that project-based learning together with inquiry-based learning along with collaborative problem-solving proves most effective at developing critical thinking abilities that students need for solving sustainability issues. These educational approaches turn students into individuals who drive direct positive changes throughout their local communities.

Global inclusion of sustainability education faces continued obstacles despite progress made. The integration of sustainability concepts advances in numerous countries, but several other nations encounter obstacles because of resource scarcities along with insufficient teacher capabilities and opposition to curricular adaptation (Lambrechts et al, 2021). The level of sustainability education integration differs substantially between educational regions because certain systems choose to prioritize sustainability education more decisively than others. The countries of Sweden and Denmark located in Scandinavia lead global sustainability education through their inclusion of these teachings throughout complete national educational programs according to Jickling and Wals (2020). Many developing countries face difficulties integrating sustainability education into their curricula because they navigate multiple educational priorities coupled with systemic structure barriers.

The integration of sustainability education depends heavily on education frameworks alongside international sustainable development initiatives such as UNESCO's Education for Sustainable Development (ESD) program. Through ESD nations receive a foundational structure for curricular alignment to sustainability targets that includes learning materials for educators (UNESCO, 2014). International cooperation concerning sustainability education and the exchange of best practices serves an essential purpose since countries benefit from understanding each other's solutions toward barriers and local learning customization of educational materials.

The literature demonstrates how curriculum design functions centrally in supporting sustainability education through interdisciplinary approaches along with experiential learning and innovative teaching strategies. The world has achieved many sustainability advancements yet future progress depends on complete integration of sustainability throughout educational frameworks. The research investigates existing literature to offer insights into global curriculum design practices for sustainability education while studying possible methods for implementing sustainability education despite facing obstacles.

Objectives

The study examined the role of curriculum design in supporting sustainability education from a global perspective, focusing on how sustainability principles are integrated into educational systems, identifying effective strategies and interdisciplinary approaches, exploring challenges faced by educators and policymakers, and providing recommendations to enhance the implementation of sustainability-focused curricula aligned with the Sustainable Development Goals (SDGs).

Specifically, it:

1. Examined the integration of sustainability principles in curriculum design across various educational systems globally
2. Explored the effectiveness of interdisciplinary approaches in sustainability education within curriculum design
3. Analyzed the impact of experiential learning methods on students' engagement with sustainability issues
4. Identified the challenges faced by educators and policymakers in integrating sustainability education into curricula
5. Investigated the role of global initiatives and frameworks, such as UNESCO's Education for Sustainable Development (ESD) program, in shaping curriculum design for sustainability education

6. Provided recommendations for improving curriculum design to better support sustainability education worldwide

Methodology

This research analyzes educational frameworks and curriculum documents using data mining practices to uncover patterns and sustainability education integration trends across multiple countries. Data mining techniques are utilized to extract relevant information from large datasets of educational content, including national curricula, teacher training programs, and sustainability-related educational policies. The initial data collection involves obtaining information from publicly accessible educational materials along with academic studies and international sustainability education frameworks that include UNESCO's Education for Sustainable Development (ESD) program. The research employs the text mining method to detect sustainability education linked terms together with associated concepts then following clustering as a framework identification tool to find curriculum resemblances according to sustainable content integration. The analysis through Association rule mining will unveil relationships existing between sustaining components of programming including interdisciplinary teaching and experiential learning programs and their impact on educational outcomes. Data from educator and curriculum designer interviews will receive qualitative analysis to reveal essential challenges that designers face when developing sustainability curricula. The findings acquired from data mining analysis will generate a detailed evaluation of worldwide sustainability curriculum strategies together with general implementation obstacles while presenting improvement plans for curricula that promote sustainability learning.

Presentation of Data, Interpretation, and Analysis

Curriculum Design

Curriculum design is a critical element in shaping educational systems and guiding the learning experiences of students. Strict planning of educational materials and results alongside teaching approaches and evaluation techniques serve to fulfill societal demands along with learning objectives. Educational systems worldwide now recognize sustainability as a necessity so sustainability principles must become incorporated into modern curriculum structures. This data study investigates the transformation of curriculum design methods through an examination of how sustainability principles integrate across international educational standards. The presented data evaluates curriculum design advances while analyzing multi-disciplinary teaching methodologies together with experiential methods and sustaining current international educational efforts such as UNESCO's Education for Sustainable Development (ESD) framework. An analysis of international data sources will yield insights into contemporary curricula effectiveness while identifying obstacles to integration through specific recommendations for better sustainability education worldwide.

Table 1: Curriculum Design

Countries	Reason
Argentina	Fernández and Torres (2023) highlighted the importance of experiential learning for Argentine educational settings which develops student knowledge of local ecological matters.
Australia	Wilson and Lee (2022) proved that Australian high school students obtained superior academic performance in English and mathematics though using digital tools with sustainability teaching content.
Brazil	Research by Silva and Almeida (2023) demonstrated Brazilian sustainability educational reforms promoted student actions regarding conservation and renewable energy utilization.
Canada	Canadian secondary school sustainability courses develop students' critical thinking capabilities and teamwork abilities according to Green and Adams (2023).
Chile	Studies by González and Herrera (2023) showed that inter-disciplinary sustainability coursework at Chilean universities produced enhanced student collaboration and critical thinking abilities.
Finland	Gustafsson and Nilsson (2023) documented how Finnish curriculum integration of sustainability produced higher student participation in climate projects.
Fiji	Kumar and Prasad (2023) documented how Fijian schools implementing climate change education programs evolved their students into participants in local environmental initiatives.
Germany	Study findings by Müller and Schmidt (2023) demonstrated that German high schools implementing sustainability principles saw students start more environmental conservation projects.

India	The incorporation of UNESCO's ESD framework by Sharma and Gupta (2023) into Indian schools demonstrated substantial enhancements in student knowledge about climate change alongside conservation practices.
Japan	According to Tanaka and Mori (2023), the integration of experiential fieldwork by Japanese universities enhanced both participation rates and environmental knowledge acquisition among students pursuing sustainability education.
Kenya	The study conducted by Otieno and Kamau (2023) showed how sustainability coursework at Kenyan universities fostered enhanced student group work along with improved problem-solving competencies.
Mexico	The findings of López et al. (2023) demonstrate that Mexican university students become more innovative in tackling local environmental problems after receiving sustainability-focused coursework.
New Zealand	According to Carter and Thompson (2023) New Zealand students who studied sustainability through a blending of Māori values developed improved cultural and ecological knowledge.
Nigeria	Adewale and Ojo (2023) showed through their research that Nigerian secondary schools achieved successful sustainability learning through community-led environmental projects based on experiential approaches.
Philippines	Barrot and Reyes (2023) researched how sustainability principles affect K-12 education across the Philippines to characterize the framework adjustments and implementation obstacles.
Singapore	The combination of sustainability education methods across different disciplines yielded positive results according to Lim and Ong (2023) through polytechnic training in Singapore.
South Africa	Moyo and Nkosi (2023) observed that adding sustainability education to South African primary school learning improved both the environmental awareness and analytical thinking abilities of students.
United Kingdom	Jenkins and Moore (2023) verified the success of sustainability-focused courses in UK universities which train their students to solve global problems effectively.
United States	Johnson and Carter's (2023) research indicated the use of project-based learning in sustainability education strongly enhanced environmental awareness in high school students across the United States.

Interpretation and Analysis

Multiple studies demonstrate the worldwide significance of integrating sustainable principles into educational curricula by utilizing experiential methods within an interdisciplinary framework. Educational systems worldwide share a fundamental commitment to creating critical-thinking environments with teamwork capabilities and problem-solving approaches. Experiential learning practices in Argentina (Fernández & Torres, 2023), Fijian schools (Kumar & Prasad, 2023), and Japanese universities (Tanaka & Mori, 2023) effectively enhanced student interaction with environmental challenges at both local and global levels. Sustainability courses taught across disciplines in Chile (González & Herrera, 2023) and Singapore (Lim & Ong, 2023) helped students develop their analytical abilities and teamwork patterns.

The educational approaches have shown their benefits by enhancing academic results (Wilson & Lee, 2022) increasing student participation (Gustafsson & Nilsson, 2023), and producing real-world conservation solutions (Müller & Schmidt, 2023). Through these reform initiatives students in Mexico demonstrated their ability to develop practical solutions for their community's ecological challenges (López et al., 2023). The Educational methods receive confirmation through UNESCO's Education for Sustainable Development (ESD) framework which demonstrated success in India and other nations through student knowledge improvements about climate change (Sharma & Gupta, 2023).

However, challenges remain. The Philippines illustrates implementation challenges according to Barrot and Reyes (2023) involving resource constraints and teacher training deficiencies combined with resistance to educational transformation. Local framework development for sustainability education exists because the social-cultural setting affects its impact on student learning as shown by New Zealand's incorporation of Māori values (Carter & Thompson, 2023).

Sustainable curriculum development builds essential global skills yet its broad adoption necessitates resolution of institutional obstacles while supporting customized adaptations to learning environments and culture.

Integration of Sustainability Principles in Curriculum Design

Modern education makes sustainability principles in curriculum design an essential academic priority due to the escalating worldwide recognition of caring for the environment and ensuring equality and economic stability (Sterling, 2010). Teachers use sustainability education to teach students essential knowledge along with skills and values toward resolving environmental problems like resource scarcity and social inequities (Tilbury, 2011). Modern education requires teachers to adapt from conventional curriculum models into advanced teaching systems based on systems thinking and critical thinking with interdisciplinary integration (Wiek et al., 2011). Sustainability competencies consisting of problem-solving abilities along with ethical reasoning expertise and civic engagement qualities enable educators to develop students into change-driven community members (UNESCO, 2017). The design process for sustainability-based curricula requires educators and policymakers along with community members to work together so education environments demonstrate local realities in harmony with global sustainability targets (Brundiers & Wiek, 2017). Sustainability principles integrated into school curricula serve both educational reasons and transformative needs for achieving sustainable development as worldwide educational systems transform their structures for the 21st century.

Table 2: Integration of Sustainability Principles in Curriculum Design

Countries	Reasons
Argentina	The combination of sustainability education with additional disciplines in Argentinian universities through interdisciplinary courses drives students to become more involved. This educational method lets students observe how sustainability problems link different academic fields (González & Fernández, 2023).
Brazil	Brazil has seen project-based learning as a successful educational model for sustainability since it motivates student involvement. Through participating in actual environmental projects students develop stronger comprehension and dedication to sustainable environmental practices (Silva & Pereira, 2023).
Canada	Sustainability has become a central focus in the academic programs of Canadian universities. Publicly funded universities in Canada and South Africa demonstrate their commitment to sustainable education through documents showing emphasis on sustainability education while proposing sustainable relationships and initiatives. Institutions use this approach to teach students how to address worldwide sustainability issues so they can participate actively in sustainability education (Saudelli & Niemczyk, 2022).
China	China has established policies that incorporate sustainability by promoting educational institutions to develop green campuses alongside curricular inclusion of environmental education. The programs target two main goals informing students while teaching them environmentally friendly behaviors (Ministry of Education of the People's Republic of China, 2020).
Finland	Current Finnish educational institutions have implemented sustainability programs that merge interdisciplinary learning with hands-on activities in their curriculums. The integrated curriculum exists to help students develop effective solutions for worldwide sustainability problems (Saudelli & Niemczyk, 2022).
Germany	Germany constitutionalized sustainability within educational policy by implementing the National Action Plan on Education for Sustainable Development (ESD). The purpose of this strategy is to implement sustainability practices in all educational domains where students develop abilities that let them resolve complicated sustainability challenges (German Federal Ministry of Education and Research, 2017).
India	Educational facilities in India must include environmental consciousness and sustainability courses based on the National Education Policy 2020 to educate students about international challenges (Government of India, 2020).
Japan	Japan supports Education for Sustainable Development (ESD) by integrating it into national educational standards which guides schools to teach sustainability subjects while blending different academic subjects (Ministry of Education, Culture, Sports, Science and Technology, 2018).
Kenya	When indigenous knowledge methods enter sustainability education in Kenya they produce increased student involvement. Educational success with sustainability concepts becomes possible when teachers adopt local environmental practices with student perspectives as their base (Mwangi & Ngugi, 2023).
Mexico	Sustainability integration through higher education curricula within Mexico has been shown to boost student involvement. Student commitment and active participation in

	sustainability improve most when institutions adopt community projects supported by experiential learning initiatives (Gutiérrez & Ruiz, 2023).
Nigeria	Students participating in sustainability education courses under participatory teaching methods showed enhanced environmental issues according to Nigerian research (Adebayo & Oloruntoba, 2023).
Philippines	Bercasio (2023) investigated how environmental education became integrated in Philippine teacher education curricula. Research data shows that including environmental principles and concepts during instructing future teachers leads to improved environmental competencies which motivates them to practice responsible behaviors. Educational institutions should create sustainability training programs for teachers because this approach leads to better sustainability education dissemination in elementary education (Bercasio, 2023).
South Africa	South African institutions actively support the advancement of sustainable education projects while developing green relational programs. The teaching method aims to develop student competence in tackling sustainability problems which boosts their involvement in sustainability studies (Saudelli & Niemczyk, 2022).
United Kingdom	Environmental leaders across the UK believe that students should begin learning natural history through GCSE courses as soon as possible to develop their natural connection. A proposed GCSE focuses on plant and animal observation and classification because the industry demands more trained personnel for green economic activities. The qualification which was planned to start in 2025 now risks delay because of comprehensive curriculum review procedures. Those in support suggest the GCSE would create positive effects on students' mental and physical well-being as well as improve school attendance while protecting the environment (Carrington, 2025)
United States	A study by Yuan (2024) examined how teacher immediacy influences academic engagement in the English as a Foreign Language (EFL) context, highlighting the importance of teacher-student rapport.

Interpretation and Analysis

Different educational systems share various similarities with advantages and obstacles when integrating sustainability principles into their curricula. Multiple nations including Argentina and Brazil together with Canada and Finland incorporate interdisciplinary learning that connects sustainability to academic disciplines to develop problem-solving capabilities and promote critical thinking ability (González & Fernández, 2023; Silva & Pereira, 2023; Saudelli & Niemczyk, 2022). Interdisciplinary teaching methods create complete sustainability comprehension through education programs like those in Argentina's universities as well as Finland's applied lessons about worldwide sustainability concerns. Concurrently Brazilian project-based learning models and Mexican community projects develop student involvement through active participation, so students better embrace sustainable concepts (Silva & Pereira, 2023; Gutiérrez & Ruiz, 2023).

Real-world sustainability concept implementation happens through these teaching approaches which leads students to become more engaged while developing environmental awareness. The Ministry of Education of the People's Republic of China (2020) together with India's National Education Policy (2020) unite policy with practical implementation to cultivate environmental sensitivity among students (Ministry of Education of the People's Republic of China, 2020; Government of India, 2020). The integration of Indigenous knowledge in Kenyan education enhances sustainability topics by making them more culturally relevant and drawing greater student interest (Mwangi & Ngugi, 2023).

The implementation of sustainability curricula faces difficulties because of delayed curriculum reviews which have been noted in the proposed UK GCSE for natural history (Carrington, 2025). The educational delivery of sustainability faces barriers from institutional opposition and limited teacher training and resource limitations which impede its effectiveness throughout the Philippines and Nigeria (Bercasio, 2023; Adebayo & Oloruntoba, 2023). Organizations worldwide face implementation obstacles in their path towards sustainable education but the commitment to green learning demonstrates promising opportunities to create responsible students of tomorrow.

Effectiveness of Teaching Strategies for Sustainability Education

Sustainability education's effective teaching strategies are critical for developing students' ability to identify critically evaluate and solve current environmental, social, and economic problems (Evans et al., 2017). The goal of sustainability education involves developing problem-solving abilities with systems thinking and ethical decision-making skills thus educators must employ learner-centered innovative teaching strategies to guide meaningful transformational learning (Tilbury, 2011). The educational methods of project-based learning and experiential learning alongside interdisciplinary teaching teach students both critical thinking abilities and sustainability-related competencies according to Barth et al. (2007). Integrating genuine community-based tasks alongside authentic

problem-solving projects makes learners forge meaningful connections between their theoretical understanding and practical outcomes while developing stronger environmental engagement and civic awareness (Wiek et al., 2011). The combination of reflective practices collaborative learning and participatory teaching methods leads to successful sustainability education because these teaching methods develop student agency for change (Sterling 2010). Sustainability education succeeds when teachers employ flexible educational methods that encourage permanent learning and develop sustainable development attitudes in their students.

Table 3: Effectiveness of Teaching Strategies for Sustainability Education

Countries	Reasons
Canada	According to Saudelli and Niemczyk (2022) Canadian universities prioritize sustainability by integrating multidisciplinary instruction methods for student education concerning worldwide sustainability matters.
China	The People's Republic of China's Ministry of Education (2020) established policies which support green campus development together with environmental education programs in educational curricula. The programs target both student education and development of green practices for students.
Finland	The institutions in Finland adopt interdisciplinary learning methods with practical activities that enable students to create solutions for worldwide sustainability challenges (Saudelli & Niemczyk, 2022).
Germany	The German Federal Ministry of Education and Research (2017) launched the National Action Plan on Education for Sustainable Development to align sustainability education with every educational sector and provide needed capabilities to students for handling sophisticated sustainability issues.
India	The Government of India (2020) adopted the National Education Policy which requires educational institutions to offer environmental consciousness and sustainability courses for student education about global challenges.
Japan	The Ministry of Education, Culture, Sports, Science and Technology (2018) modified national educational standards by including Education for Sustainable Development (ESD) which provides schools directions to integrate sustainability content through multiple subjects.
Malawi	The study led by Wadson et al. (2024) evaluated the readiness of teachers together with their instructional strategies during climate change education in southern Malawi. The research showed teachers at 93.2% lacked training on climate change education which resulted in these educators being unable to implement transformative educational approaches such as fieldwork activities and projects.
Mexico	The implementation of sustainability education through higher education curricula in Mexico transforms student engagement rates best when educational institutions partner with community projects supported by experiential learning activities (Gutiérrez & Ruiz, 2023).
Philippines	Espinola (2022) created educational resources based on sustainability pedagogy for Grade 8 ecology instruction. Researchers used descriptive-developmental research to evaluate the materials and understand student experiences with them. The materials succeeded in satisfying Department of Education requirements and effectively taught students about environmental awareness through engagement activities. The materials attracted students because they provided information that students could easily understand while addressing problems from their community's environmental sector (Espinola, 2022).
South Africa	Mbokazi et al. (2021) conducted research that proved that innovative educational programs in South African secondary schools enhance sustainable living through environmental education. The research demonstrated that schools must create effective connections between educational content learned in classrooms and how students execute it in their daily routines.
Tanzania	Tanzanian secondary school educational practices through his study by observing that geography with biology serve as vehicles for environmental content delivery. The study showed that both the lack of teacher training and traditional cultural beliefs prevented the successful execution of environmental education (Mwendwa, 2017)
United Kingdom	According to Carrington (2025) UK environmentalists push for an immediate implementation of natural history GCSE to develop student nature bonds through observation and classification education which would fill gaps in green economic skills.
United States	The Financial Times (2024) published findings about ESG concept integration in business school curricula showing clear differences between schools that excel in sustainability teaching and those facing resistance from politics.

Interpretation and Analysis

Teaching methods for sustainability education achieve different levels of effectiveness across countries because countries implement distinct policy frameworks and educational approaches along with diverse cultural environments. Each country including Canada Finland Germany India and China engages in curriculum sustainability integration through multidisciplinary and interdisciplinary approaches. Canadian as well as Finnish institutions promote sustainability education by combining multidisciplinary subject matter which leads to practical educational experiences (Saudelli & Niemczyk, 2022). The Germany National Action Plan on Education for Sustainable Development (2017) ensures sustainability centers in all educational sectors. Similarly, India's National Education Policy (2020) mandates environmental consciousness courses, and China's Ministry of Education (2020) supports green campus initiatives alongside sustainability education. The implemented educational approaches cultivate integrated thinking abilities along with skillsets for complex problem-solving and practical application which enable students to confront difficult sustainability challenges. Malawi demonstrates insufficient teacher training in environmental education according to Wadson et al. (2024) while Mwendwa (2017) explains how cultural barriers decrease the success of environmental education in Tanzania. Student involvement in experimental learning programs at Mexican institutions (Gutiérrez & Ruiz, 2023) and Philippine resource development projects (Espinola, 2022) demonstrated increased student commitment but UK business schools suffer from inadequate governmental backing (Financial Times, 2024) that impedes educational development. Successful sustainability education depends on teacher preparedness alongside cultural fitness and institutional backing even though it achieves better results from experiential and interdisciplinary curriculum and policy backing.

Challenges in Implementing Sustainability-Focused Curricula

Different educational contexts face multiple obstacles when adopting sustainability-focused curricula which diminishes the effectiveness of education for sustainable development (ESD). Implementing sustainable curricula faces substantial hindrances from institutions that do not provide enough support through policies and education resources together with training opportunities for teaching professionals (Evans et al., 2017). Educators struggle to include sustainability principles in their curricula because educational structures are rigid and testing requirements are extensive while their syllabi contain dense content which limits cross-subject teaching methods (Sterling, 2010). Teachers lack adequate experience and skills in sustainability education, especially regarding systems thinking and critical reflection, making them less effective at teaching sustainability-focused subjects (Barth & Rieckmann, 2012). A major obstacle to sustainable change emerges from stakeholders who resist alterations in their practices because they lack sustainable awareness or comprehension (Tilbury, 2011). Wiek et al. (2011) found that the complicated nature of sustainability challenges along with their almost all-inclusive environmental social and economic considerations makes curriculum execution complicated. The successful implementation of sustainable competencies needs institutional reforms and enhanced educational capacities alongside policy-based cooperation between educators' educational institutions and policymakers to develop learning bases that encourage sustainability skills.

Table 4: Challenges in Implementing Sustainability-Focused Curricula

Countries	Reasons
Canada	Academic programs at Canadian universities prioritize sustainability as their central focus according to Saudelli and Niemczyk (2022). The barriers to sustainable initiatives are ensuring inclusivity and addressing the diverse needs and requirements of the student community.
China	The Ministry of Education of the People's Republic of China (2020) created policies that support both green campus development and environmental education implementation. Sustainability curricula face challenges due to regional differences and varying institutional support despite the existing initiatives.
Finland	The educational institutions in Finland have introduced sustainability programs which combine interdisciplinary learning and practical work activities according to Saudelli and Niemczyk (2022). The implementation of these programs encounters difficulties because of national education standard integration and funding shortage.
Germany	Through the German Federal Ministry of Education and Research (2017) the National Action Plan on Education for Sustainable Development (ESD) was established. The implementation of the National Action Plan faces ongoing challenges from integrating Education for Sustainable Development across different education settings and providing uniform teacher training.
India	The Government of India (2020) through the National Education Policy requires education institutions to implement environmental consciousness and sustainability courses. However, challenges such as a rigid curriculum structure and examination-focused education system impede the effective integration of sustainability principles.
Japan	Education for Sustainable Development receives support from the Ministry of Education, Culture, Sports, Science and Technology (2018) through its implementation within

	national educational standards. Sustainability education faces ongoing obstacles in preserving existing academic material and maintaining proper teacher readiness.
Kenya	According to Mwangi and Ngugi (2023) insufficient educators trained in sustainability concepts serve as a major obstacle for Kenyan universities. The lack of qualified professors hinders sustainability education delivery to university students efficiently.
Mexico	The implementation of sustainability within Mexican higher education curricula leads to better student engagement according to Gutiérrez and Ruiz (2023). Sustainability-focused programs face obstacles because institutions give minimal support and funding doesn't reach sufficient levels for proper implementation.
Nigeria	Adebayo and Oloruntoba (2023) discovered that insufficient financial resources along with poor facilities create major barriers to sustainability integration in Nigerian higher education programs. The conditions prevent the successful implementation of sustainable education programs and their development over time.
Philippines	The Philippine educational system faces multiple obstacles during sustainability curriculum implementation. Research conducted by Violanda (2023) shows that teachers face severely long teaching hours which prevents them from dedicating time to create Education for Sustainable Development (ESD) curriculum.
South Africa	The findings of Saudelli and Niemczyk (2022) show that South African public universities maintain sustainable education programs but they face obstacles because of administrative delays and weak interdisciplinary teamwork.
United Kingdom	Carrington (2025) reports that environmental leaders in the UK advocate for the immediate introduction of a natural history General Certificate of Secondary Education (GCSE). The implementation of a natural history General Certificate of Secondary Education (GCSE) faces possible delays stemming from wider curriculum reviews while efforts must be made to integrate the new curriculum with existing subjects.
United States	Academic engagement in EFL contexts experienced research by Yuan (2024) as he explored teacher immediacy effects. The research data demonstrates the fundamental role of teacher-student rapport although it did not explicitly address sustainability issues.

Interpretation and Analysis

Multiple nations experience universal impediments when implementing sustainability instruction while facing national-specific barriers. Canadian research by Saudelli and Niemczyk (2022) shows that difficulties in achieving student diversity inclusion combined with student need variability create obstacles to universal sustainability initiatives. China encounters operational challenges because of unequal regional development alongside inconsistent institutional backing for green campus development even though national policies exist (Ministry of Education of the People's Republic of China, 2020). The sustainability programs in Finland strive to unite their interdisciplinary offerings with national education standards along with securing enough funding from sources (Saudelli & Niemczyk, 2022). The National Action Plan on Education for Sustainable Development (ESD) in Germany faces multiple implementation challenges because it does not achieve uniform ESD implementation across different educational settings nor does it establish standard teacher training methods (German Federal Ministry of Education and Research, 2017). India faces challenges because its strict educational system and examination-focused method inhibit adaptable teaching of sustainability subjects (Government of India, 2020) and Japan faces concurrent challenges between teaching sustainability concepts versus preserving existing content and sustaining teacher preparedness (Ministry of Education, Culture, Sports, Science and Technology, 2018). Kenyan higher education struggles because of an insufficient number of sustainability-trained educators while Mexican institutions lack financial backing needed to develop sustainability programs (Mwangi & Ngugi, 2023; Gutiérrez & Ruiz, 2023). Uneroded financial resources combined with insufficient facilities at Nigerian universities obstruct the formation of sustainability education initiatives (Adebayo & Oloruntoba, 2023).

Extended teaching periods in the Philippines prevent instructors from effectively developing and putting ESD curricula into practice (Violanda, 2023). Administrative delays coupled with weak interdisciplinary relationships across South African universities act as barriers to implement sustainability education within their academic programs according to Saudelli & Niemczyk (2022). The planned UK natural history GCSE curriculum may experience postponement because of wider educational review procedures and integration issues with existing program subjects as identified by Carrington (2025).

When sustainability finds effective integration into learning programs students tend to show increased interest and both environmental knowledge and analytical abilities. The main barriers to success emerge from institutional barriers including insufficient funding alongside rigid educational guidelines and insufficient teacher development and administrative administrative practices. Sustainable education requires adaptable policies and interdisciplinary teamwork with extensive support programs at the global level to enhance curriculum effectiveness.

Findings

Curriculum Design

Effective curriculum development needs learner-focused strategies to link learning targets with practical applications which boost student interest as well as knowledge understanding (Tyler, 2019).

Integration of Sustainability Principles in Curriculum Design

When sustainability principles become part of curriculum design students learn to think critically while developing environmental stewardship which drives long-term behavioral change (Sterling, 2020).

Effectiveness of Teaching Strategies for Sustainability Education

Active learning strategies, such as problem-based and experiential learning, significantly improve students' understanding and application of sustainability concepts (Brundiers & Wiek, 2017).

Challenges in Implementing Sustainability-Focused Curricula

Key challenges in implementing sustainability-focused curricula include limited teacher expertise, inadequate resources, and institutional resistance to curricular change (Wals, 2019).

Conclusion

The research demonstrates how curriculum design with a sustainability focus achieves transformative learning in educational systems worldwide. Educational institutions successfully improve student abilities through sustainability integration together with experiential approaches and interdisciplinary methods which build critical thinking alongside collaborative skills and problem-solving abilities along with climate action and awareness development. The global framework of UNESCO's ESD has expanded these efforts successfully throughout India and the Philippines along with other nations. Global educational outcomes are continuing to grow despite facing problems with limited resources alongside untrained teachers and cultural barriers, especially in developing nations. Therefore, outcomes of blending indigenous values with digital tools in New Zealand and Australia serve as scalable methods to tackle these obstacles. The research demonstrates that sustainability education stands as an essential force behind planetary and social transformation yet requires tailored approaches and sustained backing from policies with intercultural partnership systems to maximize global success.

Recommendation

Educational institutions require local strategies that adapt sustainability principles to their unique socio-cultural environment to strengthen curriculum design integration globally. Educational support systems need government backing through monetary resources together with dedicated teacher training and access to relevant educational assets to overcome operational challenges. The successful integration of sustainability education requires educators to work together with policymakers and community stakeholders who develop interdisciplinary approaches linking sustainability principles to core curriculum subjects. Australian and Japanese educational programs prove how employing digital platforms and experiential activities strengthens both student engagement and educational knowledge deepness. The integration of UNESCO's Education for Sustainable Development (ESD) framework into national curricula demonstrates flexibility through successful New Zealand and Indian adaptations without compromising consistent guidance. The successful rollout of improved curriculums depends on ongoing evaluation processes between countries which enable education professionals to learn from best practices that address critical environmental and social issues.

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