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CURRICULAR INTEGRATION OF SUSTAINABLE DEVELOPMENT: A REVIEW

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ABSTRACT

This study analyses and consolidates the transdisciplinary impacts of including Education for Sustainable Development (ESD) into courses of study in higher education. The study employed a systematic review methodology, analysing articles obtained from reputable sources such as Web of Science (WoS), Scopus, and EBSCO. The research was restricted to the period from 2019 to 2023. The research studied the effect of incorporating sustainable development education into higher education institutions on students and what teaching paradigms can promote sustainable teaching in the classroom. This study utilised a systematic review methodology and defined relevant search criteria to choose 14 publications from a total of 277 articles. This study provided recommendations for future research and curriculum enhancement in sustainable development.

Introduction

Higher education is a long-standing strategy for promoting social development in modern society. Equal access to education for everyone is one of the United Nations 17 Sustainable Development Goals (SDGs) (UNESCO, 2017). Higher education plays an important part in advancing sustainable development while also undertaking essential responsibilities and tasks (Sánchez-Carracedo *et al.*, 2021). The SDGs improve human social, environmental, and economic governance and decision-making abilities, enabling individuals to achieve sustainable living (Kioupi & Voulvoulis, 2019). To create and implement sustainable development, which is necessary to create a long-term society, education is a crucial component (Palma & Pedrozo, 2022; Ferguson, 2023). Education alters individuals' perspectives and fosters comprehension of sustainable development (Palma & Pedrozo, 2022).

Education offers individuals opportunities for ongoing development, encouraging them to make more consequential decisions and behaviours in the future (McGregor, 2013). Sustainable development is advanced by higher education, which can teach students how to achieve the SDGs (Sánchez-Carracedo *et al.*, 2021). Higher education's key impact on sustainable development is the provision of specialised training to create a skilled and competent workforce (Findler *et al*., 2019). Through interdisciplinary knowledge generation, transformational research, and instruction that can be more pertinent to the local economy, universities that engage in sustainable advocacy can support sustainable growth in regions (Sánchez-Carracedo *et al.*, 2021). Actively and effectively guiding students to acquire pertinent skills promotes the sustainable development of the social, economic, ecological, and cultural environment, and contributes to students' development as responsible and engaged citizens (Wiegand & Borromeo Ferri, 2023). Integration of sustainable development courses within pertinent university disciplines and interdisciplinary studies can tackle the world's

most urgent challenges (Wiegand & Borromeo Ferri, 2023).

Supporting the integration of sustainable development education with other related majors has the potential to strengthen students' competencies in sustainable development and to encourage students to more environmentally responsible behaviours (Sánchez-Carracedo *et al.*, 2021). Actively guiding students in gaining relevant skills fosters the social, economic, ecological, and cultural environment's sustainable growth and helps students grow into responsible, involved citizens (Wiegand & Borromeo, 2023). This underscores the necessity of sustainable development education that provides students the skills they need to handle the challenges of the twenty-first century.

Objectives

The Education for Sustainable Development (ESD) framework is a follow-up to United Nations General Assembly Resolution 72/222 (United Nations, 2018). The framework for sustainable development education comprises strategic goals and activities, with the goal of empowering people to acquire knowledge, skills, values, and attitudes that are crucial to sustainable development (UNESCO, 2019). The objective of this study is to explore the impact of integrating interdisciplinary education for sustainability into university on students' ESD competence. This review is primarily about the questions: What is the effect of incorporating education for sustainable development into university curricula on students? What pedagogical approaches can support interdisciplinary education on sustainable development? This study seeks, selects, and rates research relevant to design multidisciplinary ESD for higher education.

Materials and Methods

Overview

Moher *et al.* (2009) states that the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) is an essential tool for reviewing articles in systematic reviews and meta-analyses, as well as for critically evaluating published works. Therefore, the four-phase process proposed by Moher *et al.* (2009) is followed in this article. These four phases include identification, screening, eligibility, and inclusion.

Identification

The first phase consists of finding keywords and exploring relevant concepts using different resources, including dictionaries, thesaurus, encyclopedias, and past studies. The keyword selection was predicated on variables, including "Education for Sustainable Development", "Higher Education", "integra*", and "curricula*". These criteria were recognised as crucial for addressing the study topic and facilitating the selection of pertinent literature. Upon finalising the keywords, search strings were generated through three databases: Scopus, WoS, and EBSCO. The preliminary examination yielded a total of 277 items, as detailed in Table 1.

Screening

During the screening process, the period of search was restricted to 2019 to 2023 to incorporate current research on the latest developments and trends in ESD integration. This research was focused on journal or academic articles; thus, the preliminary search that yielded parts of book chapters, article books, conference proceedings, dissertations, documents published before 2019, and non-English articles were excluded. The study also identified 28 duplicate articles across the three databases, which were excluded from the research, as described in Appendix 1.

Eligibility

During the eligibility process, criteria for publications exclusion and inclusion were defined to ensure that the chosen studies corresponded with the aims of this research. The inclusion criteria were as follows: Empirical studies investigating the impact of incorporating sustainable development into higher education curricula on students. The exclusion criteria

Table 1: The key words of research strings

Key Words	"Education for Sustainable Development", "Higher Education", " integra*", and "curricula*"	
Terms Utilising Resources	Thesaurus, dictionaries, encyclopaedias, and previous research	
Search Strings	Scopus	TITLE-ABS-KEY ("education for sustainable development" AND "curricula*" AND "integra*" AND "higher education") AND PUBYEAR > 2018 AND PUBYEAR < 2024 AND (LIMIT-TO (DOCTYPE,"ar")) AND (LIMIT-TO (LANGUAGE,"English"))
	WoS	ALL= ("education for sustainable development" AND "higher education" AND "integra*" AND "curricula*") and 2019 or 2020 or 2021 or 2022 or 2023 (Publication Years) and Article (Document Types) and English (Languages)
	EBSCO	Search Alert: "Education for sustainable development" AND "curricula*" AND "integra*" AND "higher education" Published Date: 20190101-20231231 AND apply equivalent subjects on 2024-11-13 05:18 AM"

encompassed non-empirical studies, including systematic reviews and meta-analyses. This study also excludes articles on the effect of ESD on teacher training, analyses on course syllabuses, measuring ESD integration in universities, and evaluating ESD courses in higher education. Table 2 shows the exclusion of 43 publications after the second assessment.

Included

Stringent screening criteria led to the final selection of the 14 articles for analysis. Appendix 1 details the process.

Results

Employing the search methodology, 14 articles were obtained, evaluated, and subsequently categorised into four classifications: Sustainable development education promotes part of knowledge, attitude, and action; economic, social, and environmental; critical thinking; and sustainable learning long-term plan. Refer to Appendix 2 for the classification. This article discusses the pedagogical approaches for ESD when introducing sustainable development into higher educational institutions, as detailed in Table 3.

Table 2: The chosen criteria for the search

Criteria	Inclusion	Exclusion
Language	English	Non-English
Timeline	2019-2023	< (2019-2023) <
Publication type	Journal articles and academic articles; empirical studies investigating sustainable development into higher education curricula on students	Non-empirical studies, including systematic reviews, meta-analyses, meta-syntheses, articles, titles, abstracts, not related to higher education or lacking an emphasis on ESD integration; other types of articles were excluded that were not relevant to the main research questions
Subject area	Education for sustainable development; integrate curricula; higher education students	Besides ESD for teacher effects and training, analysis course syllabuses, measuring ESD integration in universities, evaluating ESD courses in higher education

Knowledge, Attitudes, and Action Aspect

Integrating sustainable development education within the curriculum is essential (Colón-Flores *et al.*, 2023). Education facilitates the improvement of essential competences for sustainable development (Fuertes-Camacho *et al*., 2019). Higher education can unify mentality, physique, and the spirit within a comprehensive structure (Hensley, 2020). The implementation of ESD in higher education offers sustainable attitudes, values, knowledge, and skills among learners (Zwolińska *et al*., 2022; Colón-Flores *et al.*, 2023). Colón-Flores *et al*. (2023) claim that education can facilitate the promotion of sustainable behaviours and environmental consciousness. ESD may expand a variety of knowledge (Aginako & Guraya, 2021). When students learn the basics of sustainable development and appreciate the essential concepts, environmental consciousness will improve (Jagodzińska & Strumińska-Doktór, 2022). Zwolińska *et al*. (2022) revealed that engineering students deemed it essential to cultivate sustainable knowledge. Research by Derler *et al*. (2019) demonstrate that integrating sustainability knowledge into a discipline can motivate students to achieve positive learning outcomes. Furthermore, ESD can lead to contextual knowledge and a deeper understanding of sustainability (Raath & Hay, 2019). Raath and Hay's (2019) study also found that respondents emphasised the significance of knowledge which facilitates awareness of sustainable development concerns and the requisite actions.

The cognitive domain focuses on knowledge acquisition, whereas the behavioural domain focuses on knowledge transition into action (Ahmad *et al.*, 2023). Learning through the course can enhance learners' sustainable development actions (Fuertes-Camacho *et al*., 2019; Trechsel *et al*., 2023). Learners can improve their problem-solving skills through participation in multidisciplinary teams and propose solutions to sustainability problems (Zwolińska *et al.*, 2022; Nicholson *et al*., 2023). Ahmad *et al*. (2023) developed an ESD toolkit that combines knowledge with practice, empowering individual practice through knowledge, encouraging learners to comprehend the effect they will have both locally and globally, and to make a difference in community life through action. Strachan *et al*. (2019) also expressed the opinion that ESD can bring positive effects to local community life. Higher education prepares students to think and act differently (Hensley, 2020). Zwolińska *et al*. (2022) assumes significant accountability for actions related to sustainable development. However, engineering students recognise the relevance of the SDGs but are unable to incorporate their knowledge into real-world applications (Zwolińska *et al*., 2022). Consequently, it is essential to incorporate the real-world environment in education (Derler *et al.*, 2019).

The core focus of the socio-emotional area includes attitudes, beliefs, and social abilities, which influence the perspectives and values of individuals regarding concepts. By engaging with the study of ESD, learners will develop an emotional connection to sustainable development goals (Ahmad *et al.*, 2023). ESD promotes learners' essential abilities in knowledge, attitudes, and values (Fuertes-Camacho *et al*., 2019; Ahmad *et al.*, 2023). ESD enhances students' attitudes and awareness (Carrió Llach & Llerena Bastida, 2023). A survey of teenagers about sustainable development revealed that students are becoming increasingly cognisant of its significance (Colón-Flores *et al*., 2023). Including sustainable development in the curriculum of different disciplines helps people change their perspectives (Jagodzińska & Strumińska-Doktór, 2022). As a result, by studying ESD, students can change their attitudes and actions, creating more benefit to society (Trechsel *et al.*, 2023).

Social, Environmental, and Economic Aspects

The enhancement of social, environmental, and economic aspects is affected by students (Colón-Flores *et al*., 2023). Incorporating

ESD into education can effectively promote sustainable economic innovation within the global economy (Zwolińska *et al.*, 2022; Colón-Flores *et al*., 2023). According to Colón-Flores *et al*. (2023), sustainable development education can offer a comprehensive approach that encompasses knowledge, economy, and society. Zwolińska *et al*. (2022) believes that continuous education on social responsibility is required to promptly and effectively apply the sustainable development concept within the national and global economies. Effective training can prepare students to assume societal obligations in future businesses (Ahmad *et al*., 2023). In light of environmental and social issues, significant adjustments to the curriculum are required to support a sustainable and innovative economy, particularly in regard to social, environmental, and economic implications (Zwolińska *et al*., 2022). According to Ahmad *et al*. (2023), students can effectively increase their thinking about social, environmental, and economic aspects of future industries through ESD training and take on environmental and social responsibilities. At the global and local levels, ESD improves services in areas like society, culture, economy, and the environment (Fuertes-Camacho *et al*., 2019).

Several fields undertaken significant research into sustainable development. Research on sustainable food found that students should enhance their awareness of the technical, ecological, social, and economic dimensions (Derler *et al*., 2019). In biological medicine, education enables students to contemplate the effects of culture, economics, and ecology, and to suggest sustainable alternatives (Carrió Llach & Llerena Bastida, 2023). In addition, students also think that sustainable development training is necessary (Aginako & Guraya, 2021). A rising number of empirical studies show the value of incorporating sustainable development into education. However, Aginako and Guraya (2021) show that the integration of sustainable development on society, environment and economy in electrical, electronic, and mechanical engineering majors was very low, even though students attached great importance to sustainable development. Secondly, according to Jagodzińska and Strumińska-Doktór (2022), the existing higher education system appears detached from economic, environmental, and social elements due to the restricted area of research. Universities are unique environments for the application of sustainable development principles (Jagodzińska & Strumińska-Doktór, 2022). Facing environmental and social issues, it is key to equip the younger generation with sustainable development capabilities. Therefore, higher education institutions are responsible for increasing students' knowledge of social, environmental, and economic issues (Zwolińska *et al*., 2022). Furthermore, it is necessary to integrate ESD into higher education.

Critical Thinking Aspect

Critical systems thinking plays a key role in global sustainability solutions by addressing complex sustainability issues (Nicholson *et al.*, 2023). ESD aims for thorough knowledge about environmental sustainability and encourages analytical thinking and creative methods. A survey of engineering learners in the Dominican Republic showed that ESD can enhance critical thinking (Colón-Flores *et al*., 2023). Study by Zwolińska *et al*. (2022) posits that ESD enhances work capacity, creative thinking, and practical problem-solving skills. According to a study on a sustainable development programme for higher education students in Switzerland, students gained new skills and reflected on themselves through transformative learning in sustainability. Moreover, ESD enables students to analyse issues from several viewpoints and engage in self-reflection (Hensley, 2020). Universities actively engage in sustainable development education, which can intentionally raise students' consciousness and equip them to properly instruct future generations (Jagodzińska & Strumińska-Doktór, 2022). Students appreciate critical thinking abilities and acknowledge global sustainable development challenges through ESD training (Nicholson *et al.*, 2023). Students assert that critical thinking is essential (Ahmad *et al.*, 2023). Using the third-grade geography training module as

an example, students engaged in systematic thinking and collaborative learning exercises, which enhanced their comprehensive thinking abilities (Raath & Hay, 2019).

Numerous scholars employ various research methodologies. Müller *et al*. (2020) suggested a three-stage paradigm to incorporate sustainable development education, fostering critical, and reflective learning processes. Carrió Llach and Llerena Bastida (2023) enhanced students' critical thinking through the Problem-Based Learning-Sustainable Development Goals (PBL-SDG) methodology. Ahmad (2023) created Codesigns ESD Toolkit examples to facilitate critical reflection on perspectives, aiming to tackle the complexities inESD. Sustainable education equips students with the ability to engage in critical thinking and analyse issues from various viewpoints (Hensley, 2020). Including sustainable development education in the curriculum makes students better at thinking critically about systems, which helps them in addressing the complex issues related to economy, society and the environment brought on by global sustainability difficulties (Nicholson *et al.*, 2023).

Sustainable Learning Long-Term Plan Aspect

In a complex environment, beginning with future-orientated thinking, the capacity for exploration is a crucial objective for attaining sustainable development (Ahmad *et al*., 2023). Institutions of higher education are crucial in equipping future generations for sustainable development (Nicholson *et al.*, 2023). Contributing to a responsible and sustainable future through global citizenship is critical for higher education institutions (Nicholson *et al*., 2023). Educating political and social decision-makers through ESD can instill sustainable development ideas in future generations (Jagodzińska & Strumińska-Doktór, 2022). Effective training can develop sustainable solutions for the future of work (Colón-Flores *et al*., 2023). Strachan *et al*. (2019) shows that the Vertically Integrated Projects (VIP) method, which includes ESD, in college courses can help students get better at the skills they'll need in the future. Carrió Llach and Llerena Bastida (2023) discovered that PBL-SDG imparts significance and applicability to students' personal and future endeavours. Furthermore, students believe that ESD learning may connect sustainable development to the future and integrate it into future work (Zwolińska *et al*., 2022; Ahmad *et al.*, 2023). Therefore, ESD significantly influences students' future.

Pedagogical Approach

When it involves the integration of sustainable development to educational institutions across multiple disciplines, different researchers use sustainable development pedagogical approaches in teaching. To develop a more comprehensive awareness of how ESD teaching styles affect student learning. This paper explored the diverse teaching paradigms utilised by various scholars across 14 publications. The methods include transformative pedagogy, project-based learning, enquiry-based learning, problem-based learning, mindfulness teaching strategies and vertically integrated projects.

ESD courses employ transformative pedagogy, which is essential for altering student behaviours, enhancing their abilities, empowering them and encouraging them to fill leadership roles. Transformative pedagogy promotes behavioural change and enables students to take action based on sustainable development knowledge, and actively learn about and participate in sustainable development issues (Ahmad *et al.*, 2023). Transformative education helps students develop systematic thinking skills, think more comprehensively, and transition through objective information to contextual information, content to model and structure to process, allowing them to understand the meaning of sustainability and collaborate with classmates (Raath & Hay, 2019). Transformative learning can provide learners with the opportunity to build individual perspectives and beliefs about sustainable development (Müller *et al*., 2020). An enquiry-based learning approach can significantly enhance students'

skill acquisition, employment awareness and professional literacy. Nicholson (2023) notes that enquiry-based learning pedagogy combines different ways of teaching with collaborative learning and conceptual frameworks. Enquiry-based learning has the potential to catalyse organisational changes from the grassroots level to higher education, and offers a model for sustainable development education. Based on social constructivism and interactive teaching strategies, students will apply what they have learnt to constructive tasks and reconstruction, developing their understanding of new issues and information (Fuertes-Camacho *et al.*, 2019). According to Carrió Llach and Llerena Bastida (2023), problem-based learning helps students understand how they behave, solve problems and think critically. It also helps them become important change agents who can face challenges in the future with a critical, ethical and devoted mindset. Project-Based Learning encourages students to be involved in making decisions, using real-life situations in the classroom, improving skills needed for teaching sustainable development and making them better at solving problems (Derler *et al.*, 2019). Student-led Project-Based Learning can provide students with a safe and transformative environment in which to learn new skills, self-reflect and attempt to bridge the gap between the social and professional worlds (Trechsel *et al.*, 2023).

Other scholars have proposed additional innovative teaching methods, such as Hensley's (2020) proposal to transform sustainable development education by utilising mindfulness teaching methods to foster students creativity and contemplation, and exploring and diverging thinking to address significant sustainability challenges. Strachan *et al*. (2019) introduced the Vertically Integrated Projects (VIP) pedagogical approach, implemented at the University of Strathclyde. The VIP method includes sustainable development education in undergraduate programmes. It combines teaching with community involvement and also offers the continuity and transdisciplinary characteristics of research resources essential for addressing the SDGs. VIP teaching aims to foster knowledge while encouraging engagement in deeper learning, critical thinking, effective communication and personal or community motivation among academicians (Strachan *et al*., 2019).

The pedagogy approaches for integrating ESD into higher education have proven beneficial in enhancing students' problem-solving abilities, teamwork and learning, among other aspects. In deeper learning, it facilitates students' self-reflection, cognitive processes, creativity and critical thinking. Various teaching paradigms exert distinct influences on students' capabilities. When incorporating multidisciplinary ESD in a course, it is essential to select pedagogical approaches based on the teaching objectives to achieve better educational results. Table 3 provides the details.

Discussions

This study examined how ESD programmes and pedagogy for sustainable development in higher education affect students. The overall conclusions of this research are categorised into four groups according to an in-depth literature evaluation. The four orientations encompass the knowledge, attitudes, behaviours of ESD; the social, environmental and economic aspects; critical thinking, and the sustainable learning long-term plan. Translating conceptual knowledge into personal and professional applications is a crucial factor in enhancing students' self-awareness, examining personal and professional behavioural competencies, and harnessing emotional potential (Gramatakos & Lavau, 2019; Nicholson *et al*., 2023). Information and comprehension of ESD are crucial for solving issues. Progressing from comprehension to application, students may make sustainable decisions in a variety of circumstances (Sánchez-Carracedo *et al.*, 2021). Education imparts knowledge on sustainability, encouraging students to develop values while implementing sustainable development guidelines in every aspect of their lives (Nikolic *et al.*, 2020). Economic, social and environmental

Table 3: The Pedagogy Approaches

Author (year)	Pedagogy	Pedagogy Approach Explain
Ahmad *et al.*, (2023)	Transformative Pedagogy	Can develop students' systematic thinking skills, comprehensive thinking, knowledge, and attitudes towards sustainable development.
Strachan *et al*., (2019)	Vertically Integrated Projects (VIP)	Can encourage active engagement in deeper learning, critical thinking, effective communication, and personal or community motivation in academics.
Nicholson *et al*., (2023)	Enquiry-Based Learning Pedagogy	Can enhance students' skill acquisition, employment awareness and professional literacy.
Fuertes-Camacho *et al*., (2019)	Social Constructivism & Interactive Teaching Strategies	Can improve students' problem-solving skills and capabilities.
Carrió Llach & Llerena Bastida (2023)	Problem-Based Learning (PBL)	Can help students understand how they behave, solve problems, and think critically.
Müller *et al*., (2020)	Transformative Learning	Can enable students to create distinctive thoughts and attitudes.
Derler *et al*., (2019)	Project-Based Learning (PjBL)	Can promote student involvement in decision-making and incorporate real-world contexts into education.
Trechsel *et al.*, (2023)	Student-led Project-Based Learning	Can help students learn new skills, self-reflect, and attempt to bridge the gap between clearly defined social and professional worlds.
Raath & Hay (2019)	Transformative Education	Can help students develop systematic thinking skills and think more comprehensively.
Hensley (2020)	Mindful Pedagogy	Can help students improve creativity and contemplation, exploring and diverging thinking to address significant sustainability challenges.

challenges significantly impact the development sustainability concepts (Eizaguirre *et al.*, 2019).

Students can grasp the significance of the environment, society and economy through sustainability education (Goggins & Hajdukiewicz, 2022). Efficient sustainability practices will allow them to contribute to local, regional and global economies (McConnon, 2020). With regard to critical reasoning, other authors have articulated a similar perspective. Palma and Pedrozo (2022) assert that critical thinking enhances students' analytical abilities, fosters new viewpoints, assessments and actions, and promotes engagement and diversification of sustainable practices. Nicholson (2023) found that education in sustainable development can enhance students' agency and augment their capacity to contribute to a responsible future. Ferguson (2023) asserted that a feeling of identity provides the foundation towards fostering enduring commitment to sustainable behaviours, thereby linking individuals to the environment within a long-term sustainable education framework. The perspectives of the authors align with the findings presented in this article. When ESD is integrated into the teaching paradigm of higher education, teaching ESD through different teaching paradigms is conducive to increasing learners' personal knowledge and professional skills, and is conducive to empowering students with sustainable development capabilities (Kioupi & Voulvoulis, 2019; Bertel *et al.*, 2022; Nicholson *et al.*, 2023).

This paper highlights the use of sustainable development in higher educational institutions through the close study of countries and participants in 14 scholarly papers. Of the 14 studies examined, the majority originate from developed nations: 20% of the studies were from the United Kingdom and Spain, 13.3% of the studies found in Poland, and 6.7% of the studies (one each) are from the Dominican Republic, Germany, Austria, Switzerland, South Africa, the United Arab Emirates (UAE), and Venezuela. Nathan Hensley's (2020) work did not show any research region. As shown in Figure 1. This indicates a research deficiency in combining sustainable development within educational institutions in Asia.

This research mostly examined students as the principal subjects (14 studies); the emphasis was on undergraduate participants (13 studies) and secondary school students (one study). One study involved both academic professionals and government officers. The large number of student participants shows that there is a big interest in learning more about how to teach sustainable development in higher education. Furthermore, Hensley's (2020) study did not include any research participants in its design. As the details in Table 4.

Research is mostly concentrated in Europe, South America, North America, and Africa, with no representation from Asia. Asian countries and academic groups other than undergraduates ought to be investigated in future research to get a comprehensive view of how to integrate sustainable development in higher education.

Limitation

A limitation of this study is its choice of databases, which were restricted to three: WoS, Scopus, and EBSCO. The study limited the scope of the findings by searching only relevant data from 2019 to 2023. The five-year examination limit hinders comprehensive data collection and reduces the ability to provide a comprehensive overview. This study restricts its language to English, thereby excluding articles in other languages. This article excludes books, chapters, conference papers, conference proceedings, meta-analyses, meta-syntheses, and systematic reviews. As a result, this article was limited in the scope of research analysis.

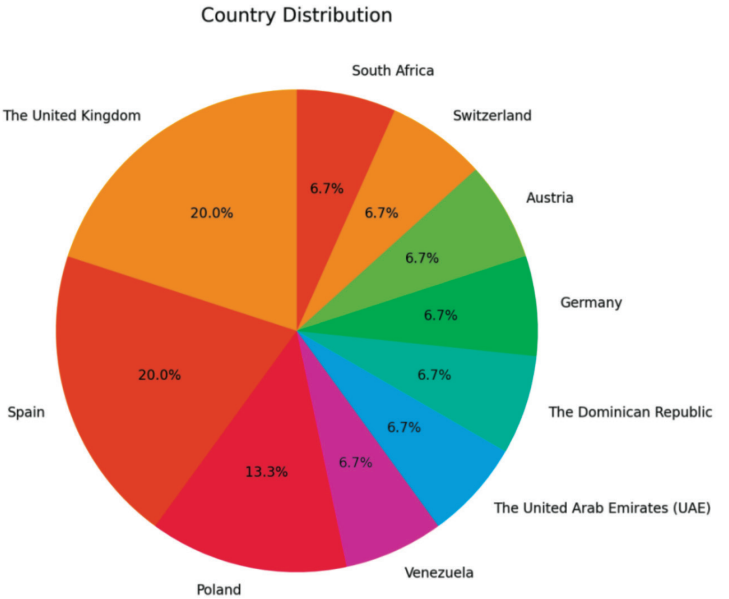

Figure 1: The country distribution

Table 4: The country and participant

Author(year)	Country/regions	Participants
Ahmad *et al*., (2023)	United Kingdom (UK), Venezuela, and United Arab Emirates (UAE)	Participants included five students, eight scholars, two instructional designers, and a government official.
Strachan *et al*., (2019)	United Kingdom	Undergraduate students
Nicholson *et al.*, (2023)	United Kingdom	Geography students
Fuertes-Camacho *et al*., (2019)	Spain	Early Childhood Education at the University Internacional de Catalunya (UIC).
Aginako & Guraya (2021)	Spain	Engineering students at the University of the Basque Country.
Colón-Flores *et al*., (2023)	The Dominican Republic	Engineering students.
Carrió Llach & Llerena Bastida (2023)	Spain	Biomedical students.
Müller *et al*., (2020)	German	Business psychology undergraduate students.
Zwolińska *et al.*, (2022)	Poland	Students of Civil Engineering and Resource Management.
Derler *et al.*, (2019)	Austria	Students at one university and two secondary schools.
Trechsel *et al*., (2023)	Swiss	Undergraduate students.
Raath & Hay (2019)	South African	Geography undergraduate students.
Hensley (2020)	/	/
Jagodzińska & Strumińska-Doktór (2022)	Poland	Pedagogy undergraduate students.

Conclusions

Researchers did a thorough review of the literature and found that education has a lot of potential to bring about changes that are needed for long-term transformation (Fuertes-Camacho *et al.*, 2019). This is crucial to solve sustainable development issues in the twenty-first century. Research data indicates that ESD can affect students' cognition, emotions and behaviours about sustainability (Hensley, 2020; Zwolińska *et al*., 2022; Colón-Flores *et al.*, 2023). Ahmad *et al*. (2023) discovered that students exhibited substantial improvements in economic, social, and environmental dimensions following exposure to pertinent training and education on sustainable development. Furthermore, students enhance their sustainable development competencies in critical thinking and sustainable long-term learning strategies (Ahmad *et al.*, 2023; Nicholson *et al*., 2023; Trechsel *et al.*, 2023).

From the perspective of sustainable development institutions and universities, sustainable development education needs to be transformed systematically and comprehensively, whether in curriculum design or pedagogical approaches (Derler *et al.*, 2019; Ahmad *et al.*, 2023; Carrió Llach & Llerena Bastida, 2023; Trechsel *et al.*, 2023). All levels of the educational institution need to integrate the concept of sustainable development through top-down organised change and cross-departmental cooperation (Raath & Hay, 2019). Comprehensive institutional

collaboration facilitates the organisation and improvement of sustainable development, while positively contributing to the establishment of sustainable cultural campuses (Strachan *et al*., 2019; Hensley, 2020). Implementing ESD into educational institutions will promote the formation of responsible, ethical, and competent learners (Zwolińska *et al.*, 2022; Ahmad *et al.*, 2023).

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Conflict of Interest Statement

The authors declare that they have no conflict of interest.

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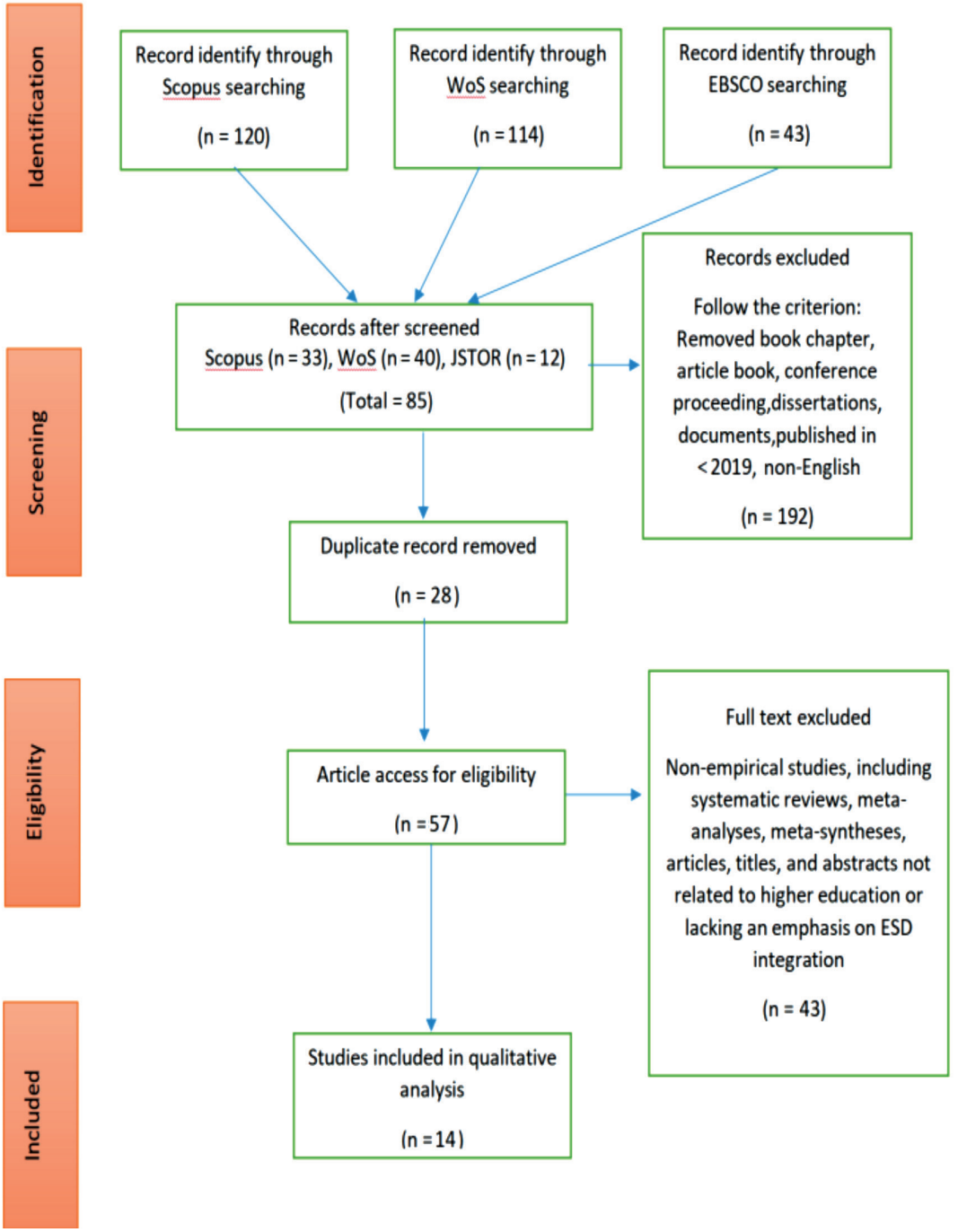
Appendices

Appendix 1



Appendix 1: Flow diagram of the proposed searching study (Moher *et al*., 2009)

Appendix 2

Appendix 2: The research article is based on the proposed searching criterion

No.	Authors (Years)	Title	WoS	Scopus	EBSCO
1	Ahmad *et al*., (2023)	CoDesignS Education for Sustainable Development: A Framework for Embedding Education for Sustainable Development in Curriculum Design	✓	✓	
2	Strachan *et al*., (2019)	Using Vertically Integrated Projects to embed research-based education for sustainable development in undergraduate curricula	✓	✓	
3	Nicholson *et al.*, (2023)	Enquiry-based skills education for sustainable development in a UK geography module as a catalyst for organisational change	✓	✓	
4	Fuertes-Camacho *et al*., (2019)	Integrating Sustainability into Higher Education Curricula through the Project Method, a Global Learning Strategy	✓	✓	
5	Aginako & Guraya (2021)	Students' Perception about Sustainability in the Engineering School of Bilbao (University of the Basque Country): Insertion Level and Importance	✓	✓	
6	Colón-Flores *et al.*, (2023)	Environmental, Social and Economic Attitudes and Sustainable Knowledge on the Sustainable Behaviour of Engineering Students: An Analysis Based on Attitudes towards Teachers	✓	✓	
7	Carrió Llach & Llerena Bastida (2023)	Exploring innovative strategies in problem-based learning to contribute to sustainable development: A case study	✓		
8	Müller *et al.*, (2020)	Using research methods courses to teach students about sustainable development - a three-phase model for a transformative learning experience	✓	✓	
9	Zwolińska *et al*., (2022)	Sustainable Development in Education from Students' Perspective-Implementation of Sustainable Development in Curricula	✓	✓	
10	Derler *et al.*, (2019)	Project-Based Learning in a Transinstitutional Research Setting: Case Study on the Development of Sustainable Food Products	✓		
11	Trechsel *et al*., (2023)	Students between Science and Society: Why Students' Learning Experiences in Transformative Spaces Are Vital to Higher Education Institutions			✓
12	Raath & Hay (2019)	Preservice Geography Students' Exposure to Systems Thinking and Cooperative Learning in Environmental Education			✓
13	Hensley (2020)	Educating for sustainable development: Cultivating creativity through mindfulness		✓	
14	Jagodzińska & Strumińska-Doktór (2022)	Using the Knowledge Acquired During Studies in Shaping Attitudes Towards Sustainable Development; [Wykorzystanie wiedzy ze studiów w kszta?towaniu postaw na rzecz zrównowa?onego rozwoju]		✓	