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Review Paper

Integrating Sustainability into Curricula: A Systematic Review of Education for Sustainable Development

Wan Norsyafiqah Arinah Wan Nor Azmi*, Nur Husna Abd Wahid, Sharifah Maryam Syed Azman & Rozita Jayus

Faculty of Social Sciences and Humanities, University of Technology Malaysia, 81310 Skudai, Johor, Malaysia

*Corresponding Author: arinah1997@graduate.utm.my

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Abstract: Integrating sustainability into curricula is crucial for preparing students to address global environmental challenges. This systematic literature review, conducted using the PRISMA methodology, focuses on identifying effective pedagogical strategies for integrating sustainability into curricula and examines their impacts on students' learning outcomes. By analyzing 28 articles published between 2019 and 2024, the review highlights key pedagogical strategies such as problem-based learning, project-based learning, and service learning. These approaches are applied across various educational levels, including school, pre-university, and university settings. Additionally, it highlights the impacts of these integrations on students' learning outcomes, including the development of Education for Sustainable Development (ESD) competencies, fostering sustainability literacy, fostering global citizenship, and preparing students for sustainability-related careers. These findings provide valuable insights for educators and institutions aiming to effectively integrate sustainability into education, thereby equipping students with the necessary skills and knowledge to tackle global environmental challenges and contribute to a sustainable future.

Keywords: Education for Sustainable Development (ESD); sustainability; curricula; systematic literature review; Sustainable Development Goals (SDGs)

Introduction

The environmental and socio-economic challenges of the 21st century, including climate change, biodiversity loss, and food security have heightened global attention and urgency for sustainable development (Mahamad Dom et al., 2023; Saleem et al., 2024; Wani et al., 2024). The sustainability discourse is increasingly framing these critical issues and emphasizing the urgent need for collective human action (Soler-i-Martí et al., 2024). In this context, Giangrande et al. (2019) highlights the crucial role of educational institutions in providing students with the knowledge, skills, values, and attitudes needed to address these complex issues. Therefore, the term Education for Sustainable Development (ESD) was introduced to clarify the role of educational institutions in equipping students with the necessary skills to understand and address the challenges of sustainabilty (Chinedu et al., 2023; Holst, 2023).

However, despite its importance, ESD faces significant implementation challenges, particularly in terms of integrating and emphasizing sustainability into curricula (Acevedo-Duque et al., 2023; Corres et al., 2024; Oggla & Soneryd, 2023). These include variations in curricula that may not consistently integrate sustainability across different countries and educational levels (Parry & Metzger, 2023; Zainal Abidin et al.,

2024). Often, sustainability education is perceived as an add-on rather than an integral part of the curriculum, leading to inconsistent application and effectiveness (Holst et al., 2024; Holst, Singer-Brodowski, et al., 2024). Furthermore, systemic barriers such as high stakes testing and a lack of teacher training heighten these challenges (Parry & Metzger, 2023; Zainal Abidin et al., 2024).

This systematic literature review aims to address this gap by compiling and analysing scholarly articles to identify key pedagogical strategies for integrating sustainability into curricula and assessing the impact of these strategies on students' learning outcomes. It provides evidence that integrating sustainability can lead to substantial benefits. This study also aims to provide actionable recommendations for educators and policymakers to enhance ESD implementation. By focusing on these objectives, the study supports efforts to overcome barriers to ESD integration, ensuring that students are well-prepared to tackle complex global challenges and fostering a more sustainable future.

Methodology

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) was chosen for this study because it provides a standardized framework that enhances the transparency and reproducibility of systematic reviews. By using PRISMA, the methodology ensures that all relevant studies are identified, assessed, and synthesized comprehensively. This approach enhances the reliability of the review by minimizing bias and allowing for a clear presentation of how studies were selected and analysed. In this study, a systematic literature review was conducted in four distinct phases to effectively address the research question, ensuring that the review was both comprehensive and focused. These phases are:

Phase 1: Identification Phase

The databases used for this systematic literature search were ScienceDirect, Google Scholar, and Education Resources Information Center (ERIC). These databases were selected due to their extensive coverage of academic literature relevant to sustainability and education, making them ideal for capturing a wide range of studies aligned with our research focus. The timeframe from 2019 to 2024 was chosen to ensure that the review includes the most recent developments and trends in sustainability education, particularly following the adoption of the United Nations Sustainable Development Goals (SDGs). This period reflects current priorities and innovations in curriculum design. Specific search terms used for each database are detailed in Table 1, while Table 2 provides an overview of additional criteria considered during article selection.

Table 1. The search string

Database	Search String
Science Direct	TITLE("sustainability issues" OR "sustainable development") AND TITLE("education for sustainable development" OR ESD) AND TITLE("sustainable development goals" OR SDG) AND TITLE(curriculum OR curricula)
Google Scholar	("sustainability issues" OR "sustainable development") AND ("education for sustainable development" OR ESD) AND ("sustainable development goals" OR SDG) AND (curriculum OR curricula)
ERIC	(TI "sustainability issues" OR TI "sustainable development") AND (TI "education for sustainable development" OR TI ESD) AND (TI "sustainable development goals" OR TI SDG) AND (TI curriculum OR TI curricula)

Table 2. Inclusion and exclusion criteria

Type of Criterion	Criteria	Inclusion	Exclusion
Language	English	✓	
	Others		✓
Publication period	2019-2024	✓	
	<2018		✓
Document Type	Articles	✓	
	Book		✓
	Book Chapter		✓
	Conference paper		✓
Source type	Journal	✓	
	Conference proceeding		✓
	Book		✓
	Book series		✓
Area	Preschool		✓
	Primary	✓	
	Secondary	✓	
	University	✓	
Term in title, abstract, or keywords	Sustainability issues	✓	
	Education for Sustainable Development	✓	
	Sustainable Development	✓	
	Curricula	✓	

Phase 2: Screening Phase

During the screening phase, all duplicate articles identified in the search across ScienceDirect, Google Scholar, and ERIC were removed. The remaining articles were then carefully reviewed to ensure they met the criteria

outlined in Table 2. This step was essential to streamline the dataset by focusing only on studies that potentially contribute to the research objectives.

Phase 3: Eligibility Phase

In the eligibility phase, an in-depth evaluation was conducted to assess the relevance and quality of the collected articles. Each article was required to meet the criteria specified in Table 1. This phase was crucial for ensuring that the data included in this study was both high-quality and reliable, thereby strengthening the validity of the review's findings.

Phase 4: Exclusion Phase

Following confirmation of article eligibility in phase 3, any remaining articles that did not meet specific inclusion criteria were excluded from the systematic literature review. Exclusions were based on several factors: articles not written in English, those not published in journals, publications dated before 2019, studies focused on preschool education, and those unrelated to curriculum design, Education for Sustainable Development (ESD), or the integration of Sustainable Development Goals (SDGs) into curricula.

Figure 1 illustrates a detailed overview of this multi-phase process from identification through exclusion, using a PRISMA flow diagram.

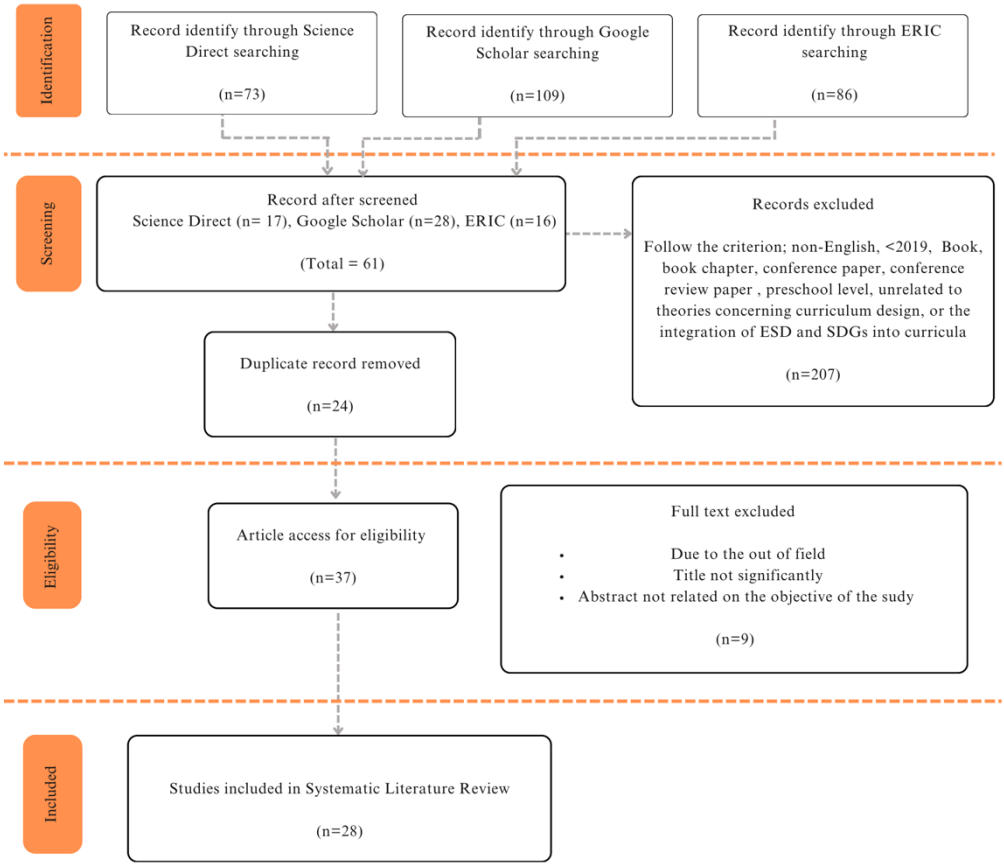

Figure 1. PRISMA flow diagram

Findings

In this section, we will discuss the trends in publications, geographical distribution, key pedagogical strategies, and the impact of integrating sustainability into educational curricula.

1. Publication Trends

The analysis of publication trends in integrating sustainability into curricula from 2019 to 2024 reveals a dynamic and evolving landscape. Figure 2 illustrates these trends, showing a total of 28 articles analyzed over six years: three in 2019, six in 2020, five in 2021, three in 2022, four in 2023, and seven in 2024. This pattern highlights a fluctuating interest, beginning with an initial surge from 2019 to 2020, where publications doubled. This increase reflects a growing global emphasis on sustainability, likely driven by international initiatives such as the Sustainable Development Goals (SDGs) (García-González et al., 2020; Kioupi & Voulvoulis, 2019; Schina et al., 2020).

However, the decline from 2020 to 2022 may be attributed to the COVID-19 pandemic, which shifted academic priorities and posed challenges for research and publication processes (Martín-Blanco et al., 2022; Wang & Huang, 2021). Additionally, the pandemic made it challenging for countries to achieve the SDGs (Mangwanya & Uwizeyimana, 2023). This period likely indicates a temporary reallocation of focus or constraints in funding for sustainability research (Arora & Sarker, 2023; Yuan et al., 2023).

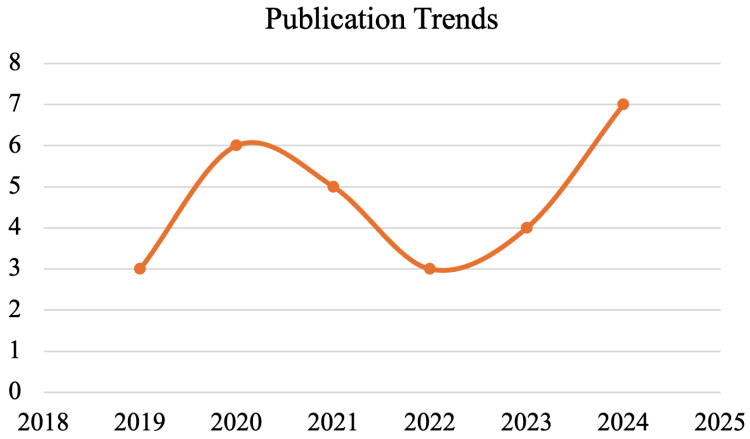

Figure 2. Publication trends

By 2023, there was a recovery in publication numbers, followed by a significant rise in 2024. This resurgence is likely driven by heightened global urgency around climate change and policy changes that emphasize integrating sustainability into education (Dean & Elliott, 2022; McKenzie, 2021; Wildemeersch et al., 2023). Additionally, post-pandemic adaptations have facilitated renewed focus and resource allocation toward sustainability research (Morrissey & Heidkamp, 2022; Zanoletti et al., 2021). Research technology and methodology advances have also enabled more innovative investigations, contributing to increase publications (Bryda & Costa, 2023; Pal, 2023). Overall, this trend highlights the complex interplay of global events, policy developments, funding availability, and societal priorities shaping academic interest in sustainability education. Continued support and investment are crucial to addressing ongoing and future challenges in sustainable development.

2. Geographical Distribution of Studies

The data from the table and chart below highlights the geographical distribution of studies on integrating sustainability into curricula. Table 3 lists a total of 28 articles, revealing the geographical distribution of studies on integrating sustainability into curricula. Spain and Malaysia are the most prominent contributors, each with five studies, indicating a concentrated effort and possibly strong institutional frameworks supporting sustainability education in these countries. Indonesia follows with three studies, showing significant regional interest.

Table 3. List of articles and countries

Article	Country
Albareda-Tiana et al. (2024), Carrió Llach and Llerena Bastida (2023), Cebrián et al. (2020), Jeong and González-Gómez (2022), and Lafuente-Lechuga et al. (2024)	Spain
Ab Wahid et al. (2020), Chinedu et al. (2023), Kanapathy et al. (2021), Ling et al. (2019), and Zakaria et al. (2021)	Malaysia
Pratiwi & Setiowati (2022), Putri et al. (2019), and Wahyuni et al. (2024)	Indonesia
Kunuba Agatha (2022), and Okafor (2023)	Nigeria
Müller et al. (2020)	Germany
Coppens et al. (2020)	Latin America
Tesfamicael and Enge (2024)	Norway
Al-kuwari et al. (2021)	Qatar
Mospan (2024)	Ukraine
Howell (2021)	United Kingdom
O'Leary and McDonnell (2024)	Ireland and Malawi
Yusof et al. (2022)	Malaysia and Indonesia
Ferreira et al. (2020)	Portugal, Latvia, and Slovenia
Zguir et al. (2021)	Qatar, Singapore, and New Zealand
Cazorla-Montero et al. (2019)	Spain and Peru
Bryhn and Belgrano (2023)	14 countries
Filho et al. (2024)	53 countries

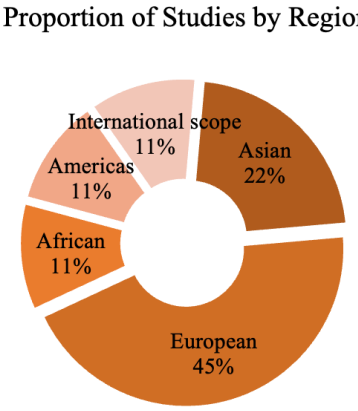

Figure 3. Study Distribution by Region

The data also highlights contributions from diverse regions including Nigeria, Germany, Norway, and Latin America, each represented by one study. This diversity underscores a global recognition of the importance of sustainability in education but also highlights uneven research activity across different regions. Additionally, some studies involve cross-country collaborations, such as those between Ireland and Malawi or Qatar, Singapore, and New Zealand, which facilitate the exchange of ideas and best practices.

However, regions like Africa and parts of Asia remain underrepresented compared to Europe and Southeast Asia, indicating potential research gaps that could be addressed to provide a more balanced global perspective. Next, studies covering multiple countries or regions, such as those involving 14 or 53 countries, suggest efforts to understand sustainability education on a larger scale. These broad-scope studies can offer valuable insights into common challenges and successful strategies across different contexts.

The chart in Figure 4 illustrates the distribution of studies by region, with a significant concentration in Europe (45%) and Asia (22%). This reflects earlier observations of notable contributions from countries such as Spain and Malaysia. Conversely, the Americas, Africa, and studies with an international focus each represent only 11% of the total. This suggests opportunities for research expansion to achieve a more balanced global representation. Increasing efforts in these underrepresented regions could enhance the understanding and implementation of sustainability practices in educational curricula worldwide.

3. Key Pedagogical Strategies for Integrating Sustainability into Curricula

This discussion highlights key pedagogical strategies for integrating sustainability into curricula, as frequently mentioned in research articles. Among these strategies, problem-based learning (PBL) is the most frequently cited, with seventeen mentions. It is followed by project-based learning, which is mentioned eleven times, and service learning, noted eight times. These approaches are widely recognized for their effectiveness in promoting ESD.

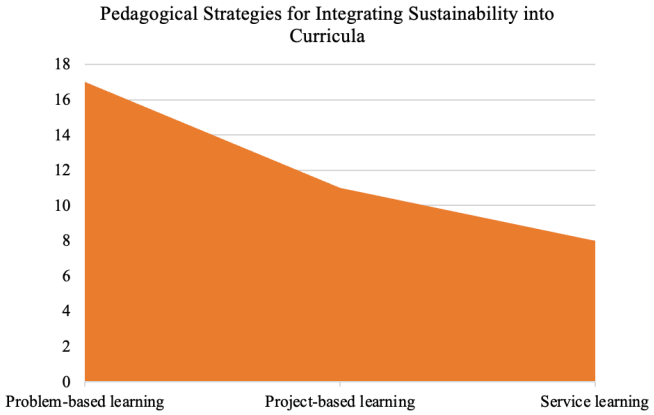

Figure 4. Key pedagogical strategies for integrating sustainability into curricula

Problem-Based Learning

Problem-based learning (PBL) is particularly relevant for sustainability education, as it encourages critical thinking and problem-solving skills (Golightly et al., 2023; Havenga et al., 2023; Pough, 2023). Based on the data below, Malaysia and Spain are at the forefront of integrating PBL into their educational systems, with Malaysia leading with four articles and Spain following closely with three articles.

Table 4. Problem-based learning articles by count

Country	Article
Spain	Carrió Llach & Llerena Bastida (2023), Cebrián et al. (2020), and Lafuente-Lechuga et al. (2024)
Malaysia	Ab Wahid et al. (2020), Chinedu et al. (2023), Kanapathy et al. (2021), and Ling et al. (2019)
Qatar	Al-kuwari et al. (2021)
Latin America	Coppens et al. (2020)
United Kingdom	Howell (2021)
Germany	Müller et al. (2020)
Indonesia	Pratiwi & Setiowati (2022), and Putri et al. (2019)
Norway	Tesfamicheal & Enge (2024)
Malaysia and Indonesia	Yusof et al. (2022)
Qatar, Singapore, and New Zealand	Zguir et al. (2021)
14 countries	Bryhn and Belgrano (2023)

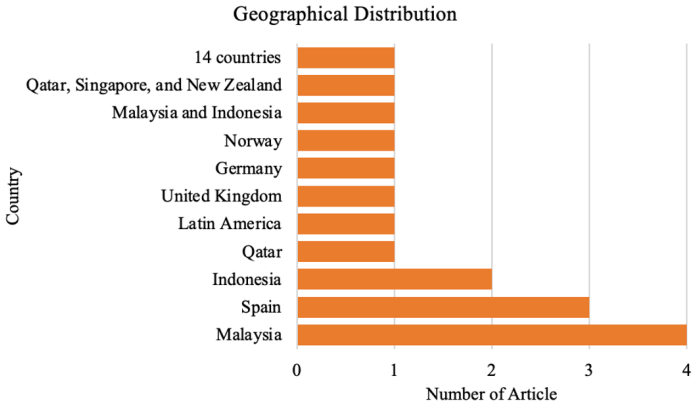

Figure 5. Number of articles on project-based learning

In Malaysia, for example, the Southeast Asian Ministers of Education Organization Regional Centre for Education in Science and Mathematics (SEAMEO RECSAM) plays a significant role in advancing PBL. The organization conducts regular courses to equip teachers with the skills necessary to implement PBL effectively in classrooms. They organize workshops focusing on global issues such as climate change, non-sustainable energy sources, and deforestation. By addressing these topics, SEAMEO RECSAM helps teachers guide students in exploring real-world problems through PBL, thereby fostering critical thinking and problem-solving skills essential for sustainable development (Shamuganathan, 2023).

Similarly, Spain has also made significant progress in implementing PBL into ESD. One example is integration into Initial Teacher Training programs. These initiatives are designed to promote changes in consumption habits and cultivate sustainability competencies among future educators (Albareda-Tiana et al., 2019). By embedding sustainability into teacher training, Spain ensures that new educators are well-prepared to integrate these essential concepts into their teaching practices.

Next, Indonesia is also recognizing the value of PBL, as reflected in two articles highlighting its effectiveness in enhancing educational outcomes, particularly in environmental education. The Indonesian government has implemented PBL in university courses (Astuti et al., 2023) and vocational education

(Aritonang, 2022) to develop practical skills and sustainability competencies among students. These efforts demonstrate Indonesia's commitment to using PBL as a tool for fostering sustainability across various educational contexts.

Overall, the implementation of PBL across different countries underscores its flexibility and effectiveness as a teaching strategy for promoting sustainability competencies. By engaging students with real-world problems, PBL not only enhances educational outcomes but also prepares students to address the complex challenges of sustainable development (SD).

Project-Based Learning

Project-Based Learning (PjBL) is recognized as an effective strategy for integrating sustainability into the curriculum, offering students a practical, hands-on approach that prepares them for real-life challenges (Kong et al., 2024; Tong, 2024; Zha et al., 2024). Based on the data below, Spain is leading the way in integrating PjBL into its educational system, as highlighted by three articles. The Spanish government acknowledges the importance of PjBL, particularly in fostering ESD. This commitment is evident through several initiatives, including the Spanish National Organic Law 3/2020, which requires educational institutions to adapt their curricula to address social, economic, and environmental changes. This law promotes the use of active methodologies, including PjBL, to advance ESD and align with the SDGs (Lozano et al., 2022).

Table 5. Project-based learning articles by country

Country	Article
Spain	Carrió Llach & Llerena Bastida (2023), Cebrián et al. (2020), and Lafuente-Lechuga et al. (2024)
Malaysia	Chinedu et al. (2023)
Ukraine	Mospan (2024)
Germany	Müller et al. (2020)
Indonesia	Wahyuni et al. (2024)
Spain and Peru	Cazorla-Montero et al. (2019)
Malaysia and Indonesia	Yusof et al. (2022)
Qatar, Singapore, and New Zealand	Zguir et al. (2021)
53 countries	Filho et al. (2024)

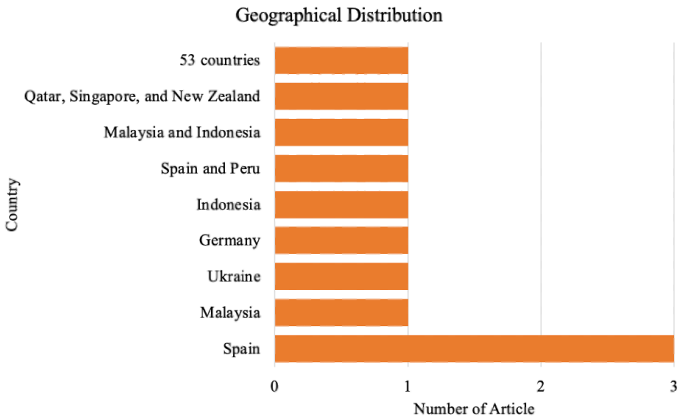

Figure 6. Number of articles on project-based learning

Malaysia is also making significant progress in integrating PjBL into its educational systems. Two articles highlight Malaysia's efforts, with one focusing specifically on Malaysia and the other including both Malaysia and Indonesia. In Malaysia, PjBL is actively implemented in Technical and Vocational Education and Training (TVET) institutions, such as Kolej Komuniti and Politeknik, to bridge the gap between academic knowledge and practical skills, aligning with industrial demands (Bakar et al., 2019). Additionally, research by Siew et al. (2020) demonstrates that the integration of PjBL in Malaysian education can foster ESD competencies by engaging students in real-world problem-solving and societal-based projects.

In addition to Spain and Malaysia, several other countries, including Germany, Ukraine, and Indonesia, are highlighted for their integration of PjBL into curricula. Furthermore, a comprehensive study, which includes insights from 53 countries, illustrates the global recognition of PjBL as an effective educational strategy. Overall, these efforts highlight the diverse applications and benefits of PjBL in various educational contexts and countries.

Service Learning

Service learning is another significant strategy, appearing in eight articles. This approach combines learning objectives with community service (Álvarez-Vanegaset al., 2024). This strategy allows students to apply academic knowledge to practical situations, thereby enhancing their learning experience and understanding of real-world problems (onzález-Cespón et al., 2024; Naufal et al., 2024). The data below shows that Spain and Malaysia are leading in integrating service learning into their educational systems, with Spain highlighted in

two articles and Malaysia appearing twice, once individually and once alongside Indonesia. In Spain, service learning is utilized as a tool to implement ESD effectively. This approach aligns with the SDGs by promoting social responsibility and community engagement among students (González-Sánchez et al., 2020).

Table 6. Service-learning articles by country

Country	Article
Spain	Carrió Llach & Llerena Bastida (2023), and Lafuente-Lechuga et al. (2024)
Malaysia	Kanapathy et al. (2021)
Germany	Müller et al. (2020)
United Kingdom	Howell (2021)
Ireland and Malawi	O'Leary & Mcdonnell (2024)
Malaysia and Indonesia	Yusof et al. (2022)
Qatar, Singapore, and New Zealand	Zguir et al. (2021)

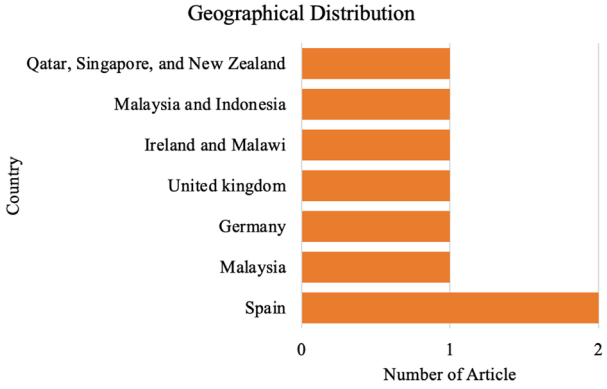

Figure 7. Number of articles on service learning

Malaysia also actively working on mainstreaming ESD through various programs and partnerships. For example, SULAM is an initiative led by the Ministry of Education (MOE) to integrate service learning into higher education as part of the Malaysia Education Blueprint 2015–2025. It aims to produce holistic graduates prepared for both academic and civic responsibilities. SULAM emphasizes experiential learning where students engage in activities that addressing community needs, aligning with ESD by promoting SDGs through practical engagement (Naufal et al., 2024). However, there is no significant difference between Spain, Malaysia, and other countries as shown in the graph above. This indicates that service learning is being integrated across various regions, reflecting a global commitment to integrate sustainability into education.

4. The Impact of Integrating Sustainability into Curricula on Students' Learning Outcomes

Figure 8. illustrates the number of articles that discuss the impact of integrating sustainability into curricula on student learning outcomes. It shows that 23 articles mention the development of ESD competencies, highlighting a strong focus on enhancing students' critical thinking and problem-solving skills. Similarly, 23 articles mention fostering sustainability literacy, indicating that this aspect is equally emphasized in the literature. Meanwhile, 19 articles discuss the impact of integrating sustainability into curricula on fostering global citizenship and preparing students for sustainability-related careers. While these areas receive slightly less emphasis than others, they remain significant in shaping a comprehensive educational approach. This highlights the importance of equipping students with the skills and awareness needed to navigate and contribute to a sustainable future.

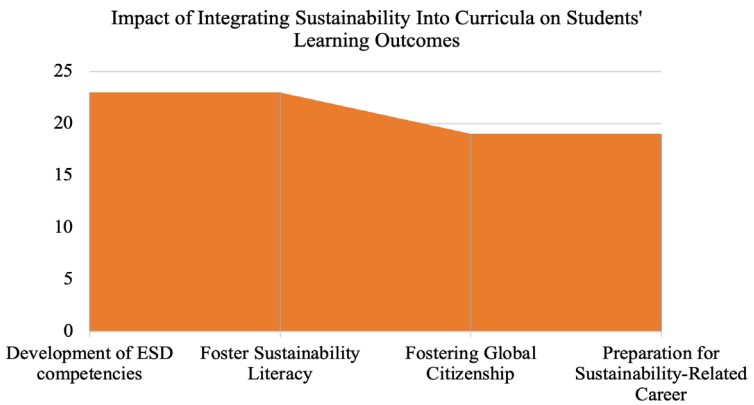

Figure 8. The impact of integrating sustainability into curricula on students' learning outcomes

ESD Competencies Development

The data from the bar and pie chart below illustrate the impact of integrating sustainability into curricula on the development of students' ESD competencies, highlighting differences between countries and educational levels. The bar chart shows that Spain, Malaysia, and Indonesia lead in research or implementation efforts, indicating a strong focus on ESD due to their proactive educational policies and initiatives aimed at embedding sustainability into their curricula. In Spain, for example, there is a notable emphasis on assessing sustainability competencies within higher education, particularly in engineering and education degrees. This assessment helps quantify how well ESD objectives are being met and allows for comparisons across different fields of study (Sánchez-Carracedo et al., 2021). Similarly, Malaysian universities are actively integrating ESD through organizational adoption and transformative strategies, highlighting their commitment to sustainability education (Syed-Abdullah et al., 2023).

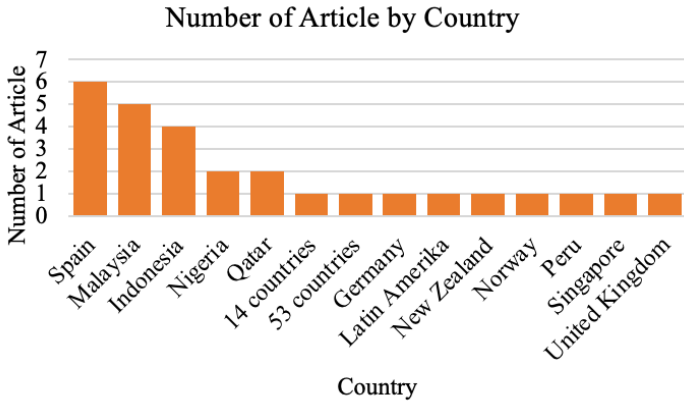

Figure 9. Number of articles by country

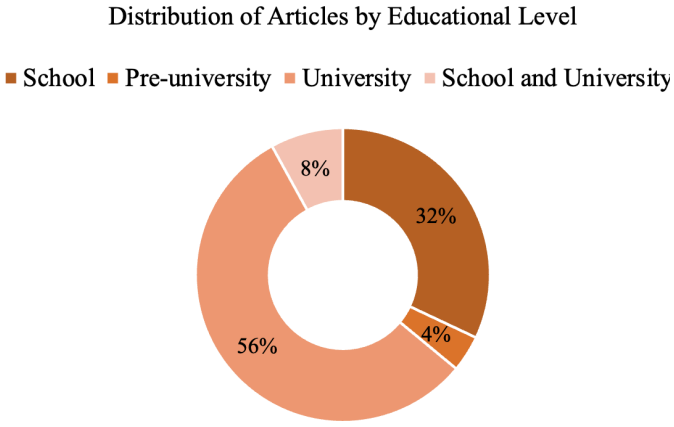

Figure 10. Distribution of articles by educational level

The pie chart further breaks down this focus by educational level in these countries. It reveals that 56% of the articles concentrate on university-level education. This significant focus highlights the role of universities in developing sustainability competencies, as they are crucial in fostering critical thinking, research, and leadership skills essential for addressing complex sustainability challenges (Filho, Sierra, et al., 2024; Price et al., 2021). Meanwhile, 32% of the articles concentrate on school-level education, highlighting efforts to integrate sustainability into curricula and equip students with the knowledge and skills needed to tackle real-world environmental issues (Mihăescu, 2020). Additionally, 8% of the articles cover both school and university levels, while only 4% focus on pre-university education. This distribution reflects an attempt to embed sustainability across various educational stages. However, the relatively low emphasis on educational levels other than higher education indicates a potential gap in developing sustainability attitudes during early education. To ensure a holistic development of ESD competencies, it is crucial to enhance efforts at all educational levels, fostering a cultural shift towards sustainability from an early age (Redman & Wiek, 2021).

Foster Sustainability Literacy

The data from the bar and pie chart below highlights the global impact of integrating sustainability into curricula, emphasizing its role in fostering students' sustainability literacy. The bar chart shows that Spain and Malaysia are leading with six articles each, followed by Indonesia with five, indicating these countries' active engagement in promoting sustainability education. This high number of articles suggests a strong regional commitment to sustainability education. In Spain, this commitment is driven by strategic institutional responses and national policies like the Royal Decree 822/2021, which encourages integrating SDGs into curricula (Andrades et al., 2024). In Indonesia, the Adiwiyata program demonstrates the implementation of sustainability in curricula across rural and urban areas, fostering environmental awareness and conservation efforts among students (Sagala, 2019).

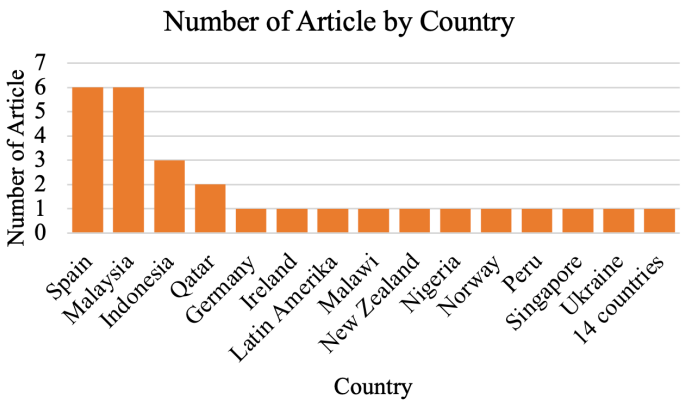

Figure 11. Number of articles by country

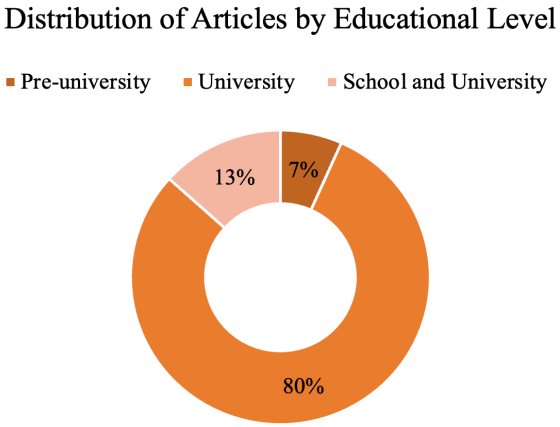

Figure 12. Distribution of articles by educational level

The pie chart categorizes the educational levels emphasized in these countries. The pie chart shows that 80% of the efforts to foster sustainability literacy are concentrated at the university level, highlighting the significant role of higher education institutions. Universities have the resources and research capabilities to effectively integrate sustainability into their curricula, preparing students for global challenges like climate change and resource management (Filho et al. 2024). However, this strong emphasis on universities might limit the reach of sustainability education, potentially neglecting primary and secondary education levels where early attitudes toward sustainability can be nurtured. To fully achieve the SDGs, a more inclusive approach is needed, integrating sustainability across all educational levels (Parry & Metzger, 2023; Rad et al., 2022). While universities are crucial for developing informed leaders, a broader strategy is needed to promote sustainability literacy from early education onwards (Sharma, 2023). This comprehensive approach would ensure a cultural shift towards sustainability, equipping individuals at all life stages with essential knowledge and skills for a sustainable future (Biswas et al., 2021; Dahl, 2019).

Foster Global Citizenship

The data from the bar and pie charts below highlights that articles discussing the integration of sustainability into curricula emphasize its impact on fostering global citizenship among students. Spain leads with five articles on this topic, followed by Indonesia and Malaysia with three each. These countries recognize the advantages of fostering global citizenship and are actively working to achieve this goal.

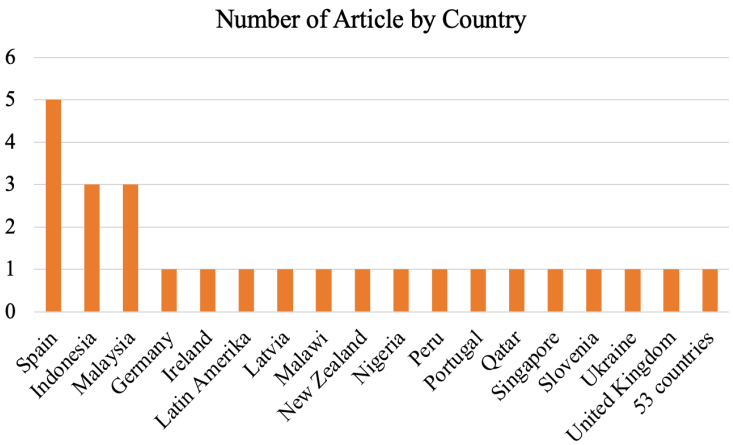

Figure 13. Number of articles by country

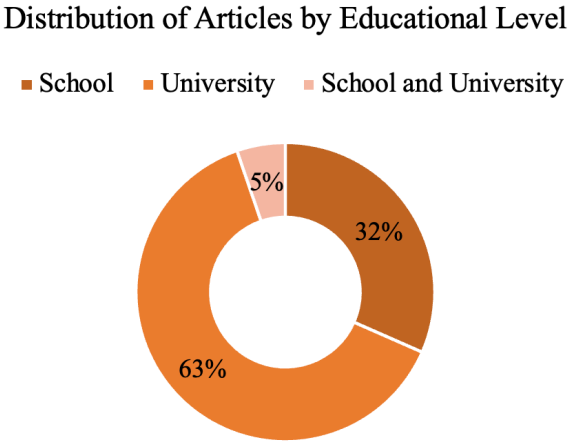

Figure 14. Distribution of articles by educational level

In Spain, the education system integrates citizenship education as part of its curriculum, emphasizing democratic values, tolerance, and social responsibility. The inclusion of subjects like Education for

Citizenship and Human Rights reflects Spain's strategic approach to foster global awareness among students (García-Alvarez & Arias-García, 2022). In Indonesia, global citizenship education (GCE) is gradually being integrated into the school curriculum (Mahpudz, 2023). Although GCE is not yet fully embedded in all educational levels in Indonesia, efforts are underway to enhance civic education with a global perspective (Usmia & Samsuri, 2023). Next, Malaysia's approach to GCE involves embedding these principles within existing subjects to promote the principles and values of global citizenship (Zakaria et al., 2021).

The pie chart categorizes articles by educational level, showing that 63% of articles focus on university-level initiatives. This highlights the significant role of higher education institutions in promoting global citizenship, as universities often have the resources and platforms to engage in international collaborations and research (Grad & van der Zande, 2022). However, the chart also shows that 32% of efforts are at the school level, and 5% span both school and university levels. This indicates a growing recognition of the importance of introducing global citizenship concepts early in education (Torres & Bosio, 2020). Therefore, a more inclusive approach is needed to ensure that concepts of global citizenship are integrated across all educational levels (Estellés & Fischman, 2021). A comprehensive strategy involving primary, secondary, and higher education can foster a cultural shift towards embracing global citizenship, ensuring individuals are prepared to contribute positively to a diverse and interconnected society.

Prepare Students for Sustainability-Related Career

The data from the bar chart and pie chart below provides a comprehensive overview of the global focus on integrating sustainability into curricula to prepare students for sustainability-related careers. The bar chart shows that Spain leads with four articles, closely followed by Malaysia with three, reflecting these countries' dedication to prepare students for sustainability careers, through initiatives that emphasize practical applications and industry collaboration (Rizwan et al., 2021; Ursić et al., 2022). Indonesia and Nigeria, each with two articles, show moderate engagement, indicating a growing interest in enhancing sustainability education. Other countries, such as Germany and Ireland, have one article each, highlighting a widespread but varied global interest in sustainability education.

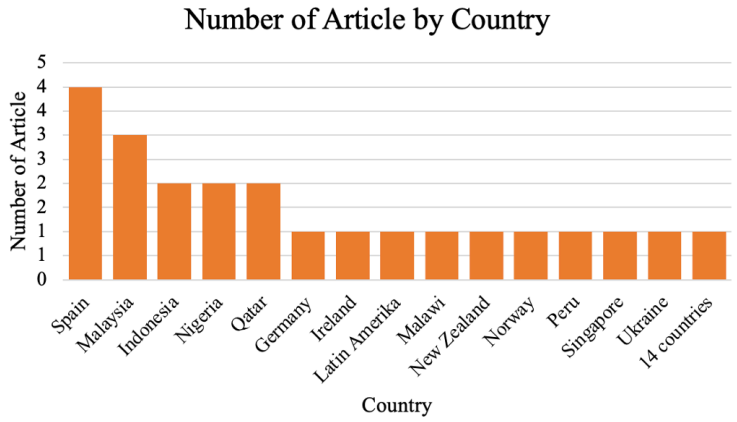

Figure 15. Number of articles by country

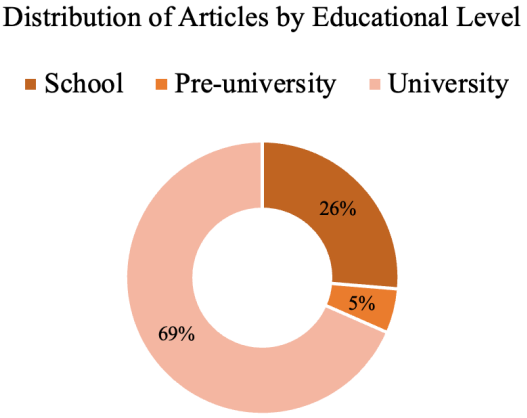

Figure 16. Distribution of articles by educational level

The pie chart categorizes these articles by educational level, showing that 69% focus on the university level, emphasizing the crucial role of higher education in preparing students for sustainability-related careers. In Malaysia, for example, the UTM-Industry Innovation Exchange (UNIX) program at Universiti Teknologi Malaysia exemplifies effective collaboration in this area, addressing immediate educational needs and contributing to long-term career sustainability (Abd Manan & Alwi, 2020). However, only 26% and 5% of articles focus on school and pre-university levels, respectively, highlighting a significant gap in early-stage education. This imbalance suggests missed opportunities to integrate sustainability concepts at foundational stages, which are essential for developing a comprehensive understanding and commitment to sustainability from a young age (Collins & Garrity, 2023; Sihvonen et al., 2024). Addressing this gap could involve

integrating sustainability into school curricula and providing experiential learning opportunities that connect students with real-world environmental issues (Butler, 2022; Martínez-Borreguero et al., 2024). Such efforts would ensure that students develop the necessary skills and knowledge for sustainability-related careers early on, ultimately fostering a generation equipped to contribute meaningfully to the SDGs (Hamadi et al., 2024).

Conclusion

This systematic literature review emphasizes the importance of integrating sustainability into curricula to equip students with the knowledge, skills, and values needed to address complex global challenges. The diverse pedagogical strategies identified, such as problem-based learning, project-based learning, and service learning, demonstrate a global commitment across various educational levels and disciplines. Policymakers can leverage these findings to develop educational policies that mandate the integration of sustainability, ensuring consistency and quality in ESD. Standardizing framework that supports educators in embedding sustainability can significantly enhance implementation. Educational institutions can redesign curricula to prioritize sustainability by implementing active learning strategies. These approaches foster critical thinking and global citizenship while also preparing students to become proactive participants in sustainable practices.

Establishing partnerships with industry and community organizations can provide students with real-world learning opportunities, thereby enhancing the practical applications of sustainability concepts. Future research should explore the long-term impacts of ESD on students' career paths and personal sustainability practices through longitudinal studies. Additionally, investigating cross-cultural effectiveness, the role of digital technologies, and interdisciplinary teaching strategies could offer tailored approaches for diverse educational settings. By addressing these areas, future research can refine our understanding of effective ESD practices, contributing to a more sustainable future.

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