Embedding Sustainability into Curriculum: Bibliometric Review of Higher Education Research 1996 to 2025

Neni Nuraeni[1], Puspo Dewi Dirgantari[2], Kiki Aryani[3], Wiji Safitri[4] and Fitrina Lestari[5]

[1,2,3,4,5] Indonesia Universityof Education, Bandung, Indonesia
neninuraeni@upi.edu

Abstract. This study maps global research on sustainability integration into higher education curriculum and identifies intellectual patterns, thematic directions, and future research needs. Using Scopus data, a bibliometric approach was conducted with Bibliometrix, Biblioshiny, and VOSviewer. The analysis covered publication growth, leading sources, author contribution, country productivity, keyword structure, thematic evolution, and keyword co-occurrence. Results show that sustainability curriculum research has shifted from broad conceptual discussion toward applied concerns, including curriculum design, pedagogy, student competence, institutional policy, and leadership. Three research streams shape the field: curriculum and policy implementation, student attitudes and behavior, and digital or systems-based support for sustainability education. The discussion shows that this field is increasingly aligned with global sustainability agendas, although research visibility remains concentrated in countries with stronger publication infrastructures. This study concludes that embedding sustainability in higher education requires interdisciplinary curriculum design, institutional commitment, educator capacity building, and inclusive research collaboration to strengthen sustainability learning across higher education systems.

Keywords: Sustainability in Higher Education, Bibliometric Analysis, Curriculum, Pedagogy, Sustainable Development.

1 Introduction

Sustainability has become a strategic agenda in higher education as universities are expected to prepare graduates for climate, environmental, social, and development challenges [1]. Through education for sustainable development, universities act not only as knowledge producers but also as learning spaces that develop systems thinking, anticipatory competence, collaboration, ethical judgment, and responsible action [2,3]. Thus, sustainability integration requires curriculum redesign, institutional commitment, transformative pedagogy, and stakeholder engagement, rather than isolated course content [4,5,6]. This study maps global research on sustainability integration into higher education curriculum from 1996 to 2025 by identifying key themes, contributors, intellectual patterns, and future research gaps.

© The Author(s) 2026
R. Hurriyati et al. (eds.), *Proceedings of the 10th Global Conference on Business, Management, and Entrepreneurship (GCBME 2025)*, Advances in Economics, Business and Management Research 407,
https://doi.org/10.2991/978-94-6239-819-1_92

Research on this topic spans curriculum design, pedagogy, institutional transformation, sustainability assessment, and graduate capability development [2,3,6,7,8]. Sustainability curriculum is therefore a holistic educational process involving learning outcomes, teaching strategies, assessment, campus culture, governance, community engagement, and transformative learning [4,5,9,10]. Bibliometric analysis is relevant because it can map publication growth, key authors, journals, keyword structures, thematic evolution, and conceptual networks [11,12,13,14].

Although previous bibliometric reviews have advanced this field, many remain limited to selected periods or broad sustainability education themes [15,16]. A focused mapping is needed to clarify temporal development, international contributions, emerging themes, and links among curriculum, pedagogy, policy, institutional change, and sustainability outcomes [1,12,13]. By combining performance analysis and science mapping, this article provides concise evidence for curriculum development, policy support, educator capacity building, and international collaboration [11,12,14].

2 Methods

This study employed a bibliometric design to examine global research on sustainability integration into higher education curriculum because this approach enables the mapping of scientific productivity, intellectual structure, conceptual relationships, and thematic development in an expanding research field [11,12,13]. Data were collected online from Scopus in July 2025 because Scopus provides broad coverage of peer reviewed international publications, although it may underrepresent regional journals and non-English scholarship [17]. The search was limited to English language journal articles published between 1996 and July 2025 using the Boolean logic: sustainability AND higher education AND curriculum OR teaching OR pedagogy OR learning design OR syllabus. The initial search generated 3,522 documents; after removing 298 duplicate or inconsistent records and excluding 130 articles unrelated to curriculum, pedagogy, teaching, or higher education transformation, 2,172 articles were retained for analysis. The dataset was exported in BibTeX format and analyzed using Bibliometrix, Biblioshiny, and VOSviewer; Bibliometrix and Biblioshiny were used to calculate descriptive indicators and thematic evolution [11], while VOSviewer was used to visualize keyword co-occurrence networks and thematic clusters [14]. Quantitative outputs were interpreted through close reading of representative studies to connect bibliometric patterns with educational meaning [12,13].

Table 1. Main bibliometric information

Indicator	Result
Timespan	1996 to 2025
Initial documents	3,522
Final articles after screening	2,172
Sources	1,360
Annual growth rate	23.2 percent

Average citations per document	17.08
Authors	9,628
Co authors per document	3.28
International co authorship	23.45 percent

Source: Author's work

3 Results and Discussion

3.1 Publication Growth and Field Maturity

Annual scientific production indicates that sustainability curriculum research in higher education expanded strongly after 2018, reflecting scholarly consolidation in higher education for sustainable development [15,16], a shift toward institutional transformation and sustainability commitment [4,6], growing attention to curriculum reform and pedagogical transformation [9,18], and stronger alignment with the Sustainable Development Goals, particularly quality education, climate action, and higher education responsibility for sustainable development [1].

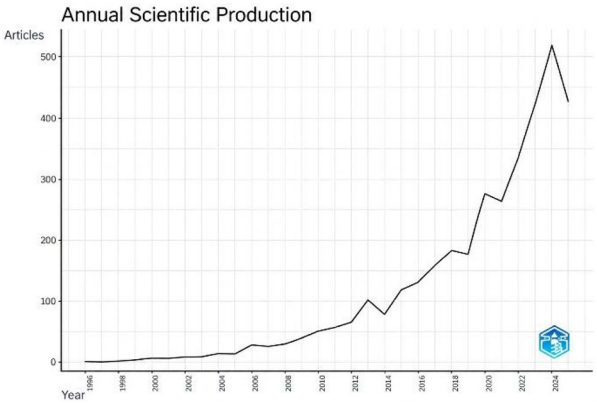

Fig 1. Annual Scientific Production

The growth pattern shows that sustainability curriculum research has shifted from conceptual justification and university responsibility [4,6] toward implementation through curriculum design and sustainability competencies [2,3,9], pedagogical transformation and educator capacity [5,19], student engagement and learning outcomes [3,7], and institutional leadership, assessment, graduate attributes, and campus based learning experiences [6–8].

3.2 Source, Author, and Country Patterns

The leading sources and contributors show that sustainability curriculum research has developed as an interdisciplinary field linking education, environmental management,

institutional governance, applied sustainability science, and curriculum studies [2,4,5,9,15,20]. The prominence of Walter Leal Filho and Rodrigo Lozano reflects sustained attention to institutional commitment, sustainability leadership, and curriculum integration [4,5,6,20], while collaborative authorship patterns confirm the multidisciplinary nature of sustainability education through its links with competencies, governance, and behavioral change [2,3,5,6,8]. Country production remains concentrated in the United States, United Kingdom, Spain, Australia, and Portugal, indicating stronger research infrastructure, indexed journal access, and Global North visibility [1,17], while the limited visibility of Southeast Asia, Sub Saharan Africa, and Latin America highlights the need for regional databases, multilingual scholarship, and more inclusive citation practices [1,15,17].

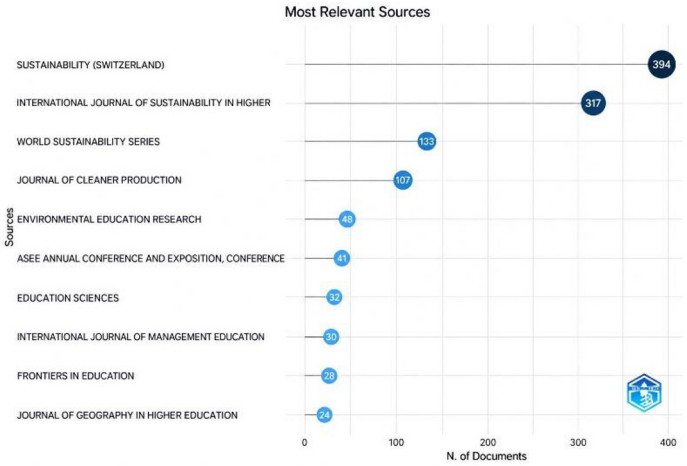

Fig 2. Most Relevan Publication Sources

3.3 Keyword Structure and Thematic Evolution

Keyword and thematic analyses show that sustainability curriculum research is centered on higher education, sustainability goals, curriculum practice, student learning, and institutional responsibility [2,7,9], while teaching, curricula, and students indicate a learning process involving pedagogy, competencies, assessment, and learner transformation [3,5,8,19]. The emergence of climate change, environmental education, innovation, experiential learning, and sustainable development goals shows expansion into ecological, behavioral, institutional, technological, and policy dimensions [2,5]. Thematic evolution further indicates a shift from foundational debates on university responsibility, sustainability competencies, and institutional commitment [3,4,9,10] toward implementation, educator capacity, measurable learning outcomes, and global development alignment [1,5,19].

3.4 Keyword Co Occurrence Clusters and Conceptual Meaning

Keyword co-occurrence mapping reveals three clusters: curriculum and policy implementation, which translates sustainability principles into curriculum frameworks, learning outcomes, institutional policy, and governance [4,6,21]; attitude and behavior, which explains adoption through motivation, awareness, perception, readiness, and competence development among students, educators, and institutions [2,3,5,8,19]; and digital and analytical support, which reflects growing use of information systems, modeling, platforms, and decision support for curriculum planning, student engagement, monitoring, and sustainability assessment [7,11,14,22].

The interconnection among clusters shows that sustainability curriculum research is increasingly integrated, linking curriculum and policy studies with behavioral research, while digital and systems-based studies support monitoring, evaluation, and decision making [7,14,20,22], because curriculum transformation requires alignment among academic vision, institutional policy, pedagogy, technology, campus practice, assessment, and student experience [4,6,8,20].

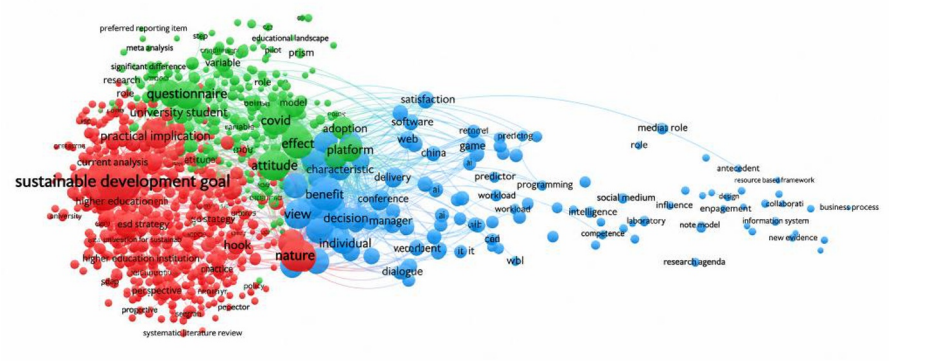

Fig 3. Keyword Co-occurrence Network: Thematic Clusters and Conceptual Mapping

3.5 Contribution And Future Direction

Compared with earlier reviews limited by period or theme, this study offers a broader longitudinal map of sustainability curriculum research [15,16] by integrating publication trends, source analysis, author productivity, country distribution, keyword frequency, thematic evolution, and cooccurrence mapping [11–14]. Future research should move from descriptive mapping toward evaluating educational impact on competencies, behavior, employability, civic engagement, institutional performance, and sustainability assessment outcomes [3,5,7,19], while giving greater attention to underrepresented regions, non-English publications, indigenous knowledge, and context specific practices [1,17]. For practice, the findings support policy frameworks, curriculum standards, educator development, interdisciplinary courses, experiential learning, living laboratories, community engagement, and future empirical curriculum evaluation [1,2,5,7,8,12].

4 Conclusion

This study shows that research on sustainability integration into higher education curriculum has developed from conceptual discussion toward more practical concerns, including curriculum implementation, pedagogical innovation, institutional leadership, student engagement, and alignment with sustainable development goals. The bibliometric findings indicate three main research streams: curriculum and policy implementation, attitudes and behavior, and digital or systems-based support for sustainability education.

Although scholarly attention to this field continues to grow, the research landscape remains uneven because contributions are still concentrated in countries with stronger research infrastructure and higher publication visibility. Future studies need to broaden data sources, include regional and multilingual scholarship, and examine how sustainability curriculum integration affects actual learning outcomes. For higher education institutions, sustainability should be embedded not only as course content, but also as a learning culture that connects curriculum, campus practice, research, and community engagement.

Acknowledgments. The authors gratefully acknowledge Universitas Pendidikan Indonesia for academic support during the preparation of this study. The authors also thank colleagues and reviewers who provided constructive input for improving the clarity, structure, and relevance of this manuscript.

References

1. Chankseliani, M. & McCowan, T.: Higher education and the Sustainable Development Goals. High. Educ. (Dordr). **81**, 1–8 (2021)
2. Wiek, A., Withycombe, L. & Redman, C. L.: Key competencies in sustainability. A reference framework for academic program development. Sustain. Sci. **6**, 203–218 (2011)
3. Brundiers, K. et al.: Key competencies in sustainability in higher education—toward an agreed-upon reference framework. Sustain. Sci. **16**, 13–29 (2021)
4. Lozano, R. et al.: A review of commitment and implementation of sustainable development in higher education. Results from a worldwide survey. J. Clean. Prod. **108**, 1–18 (2015)
5. Leal Filho, W., Pallant, E., Enete, A., Richter, B. & Brandli, L. L.: Planning and implementing sustainability in higher education institutions. an overview of the difficulties and potentials. International Journal of Sustainable Development and World Ecology **25**, 712–720 (2018)
6. Findler, F., Schonherr, N., Lozano, R., Reider, D. & Martinuzzi, A.: The impacts of higher education institutions on sustainable development. A review and conceptualization. International Journal of Sustainability in Higher Education **20**, 23–38 (2019)
7. Caeiro, S., Sandoval Hamón, L. A., Martins, R. & Bayas Aldaz, C. E.: Sustainability assessment and benchmarking in higher education institutions. A critical reflection. Sustainability **12**, 543 (2020)
8. Aleixo, A. M., Leal, S. & Azeiteiro, U. M.: Conceptualization of sustainable higher education institutions, roles, barriers, and challenges for sustainability. An exploratory study in Portugal. J. Clean. Prod. **172**, 1664–1673 (2018)

9. Barth, M., Godemann, J., Rieckmann, M. & Stoltenberg, U.: Developing key competencies for sustainable development in higher education. International Journal of Sustainability in Higher Education **8**, 416–430 (2007)
10. Sterling, S. Sustainable Education: Re-Visioning Learning and Change. (Green Books, 2001)
11. Aria, M. & Cuccurullo, C.: Bibliometrix. An R tool for comprehensive science mapping analysis. J. Informetr. **11**, 959–975 (2017)
12. Donthu, N., Kumar, S., Mukherjee, D., Pandey, N. & Lim, W. M.: How to conduct a bibliometric analysis. An overview and guidelines. J. Bus. Res. **133**, 285–296 (2021)
13. Zupic, I. & Cater, T.: Bibliometric methods in management and organization. Organ. Res. Methods **18**, 429–472 (2015)
14. van Eck, N. J. & Waltman, L.: Software survey. VOSviewer, a computer program for bibliometric mapping. Scientometrics **84**, 523–538 (2010)
15. Hallinger, P. & Chatpinyakoop, C.: A bibliometric review of research on higher education for sustainable development, 1998 to 2018. Sustainability **11**, 2401 (2019)
16. Hallinger, P. & Nguyen, V. T.: Mapping the landscape and structure of research on education for sustainable development. A bibliometric review. Sustainability **12**, 1947 (2020)
17. Mongeon, P. & Paul-Hus, A.: The journal coverage of Web of Science and Scopus. A comparative analysis. Scientometrics **106**, 213–228 (2016)
18. Leal Filho, W. et al.: The role of transformation in learning and education for sustainability. J. Clean. Prod. **199**, 286–295 (2018).
19. Redman, A. & Wiek, A.: Competencies for advancing transformations towards sustainability. Front. Educ. (Lausanne). **6**, 785163 (2021).
20. Lozano, R., Lozano, F. J., Mulder, K., Huisingh, D. & Waas, T.: Advancing Higher Education for Sustainable Development. International insights and critical reflections. in Journal of Cleaner Production vol. **48** 3–9 (Elsevier Ltd, 2013).
21. Lozano, R., Lukman, R., Lozano, F. J., Huisingh, D. & Lambrechts, W.: Declarations for sustainability in higher education. Becoming better leaders, through addressing the university system. in Journal of Cleaner Production vol. **48** 10–19 (Elsevier Ltd, 2013).
22. Schaltegger, S., Beckmann, M. & Hansen, E. G.: Transdisciplinarity in corporate sustainability. Mapping the field. Bus. Strategy Environ. **22**, 219–229 (2013).

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (http://creativecommons.org/licenses/by-nc/4.0/), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

