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Efforts by Universities to Promote Sustainability Competence Over The Last Few Decades : A Systematic Literature Review

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Abstract: This study analyzes the efforts by universities to promote sustainability competence over the last few decades and it is anticipated that it will make a valuable contribution to the advancement of literacy studies about education for sustainable development (ESD). This study employed a systematic literature review (SLR) method adapted from the PRISMA model. Qualitative data collection techniques were employed, followed by thematic analysis for data interpretation. This SLR obtained several interesting findings. It was found that the theme of SC was first collected in the Scopus database in 2009, and the increasing SC-higher education occurred during and post-COVID-19 pandemic, namely from 2020 to 2023. Various efforts have been made by universities around the world to promote SC. Their focus is on strengthening SC to realize the ESD and achieve SDGs through strengthening active learning, strengthening students and teachers, and reformulating and adapting the curriculum. It was also found that the author's country of origin is still dominated by countries in the European region, namely Spain, Sweden, and England. This fact is also supported by the concern of funding sponsors from Europe in funding research and publications regarding sustainability competencies. Therefore, this theme needs to campaign widely on other continents, especially Asia, Africa, Oceania, and America because its role and position are also important for sustainability.

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Introduction

Sustainability competence (SC) relates to integrated knowledge, skills, attitudes and values; as an effort to empower every individual to take an effective role in facing the challenges and opportunities of world sustainability (Bianchi, 2020). The SC is crucial in higher education, notably during the industrial revolution. It encompasses systems, future, and value thinking, collaboration, and action-oriented skills. Bridging the gap between students' aspirations and the actual integration of SC in their education is essential amidst digital advancements (Scalabrino, 2022). Overall, SC is essential to ensure environmental, social, and economic sustainability; which means anticipating various challenges and problems that accompany it (Lenhart & Bouwma-Gearhart, 2022).

The campaign regarding the urgency of SC began to be promoted in the world of higher education along with the implementation of education for sustainable development. Researchers and observers in higher education have begun to take an interest in this topic in the last three decades. Mainstreaming SC in higher education is very urgent, considering the need to promote education for sustainable development (ESD) and sustainable development goals (SDGs) (Lambrechts et al., 2017). In this regard, based on the results of a search on the Scopus database carried out in April 2024, it was found that there were 146 publications on

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the theme of SC in the last 30 years or 2009-2024 (out of a total of 766 for the all-fields category). Referring to this data, the new SC theme was first documented in the Scopus database in 2009, related to the topic of bachelor engineering education competencies at three European universities (Segalàs et al., 2009).

These publications need to be analyzed in depth to find interesting information, trends, and newest research. One of the most recommended techniques for study and analysis is a Systematic Literature Review (SLR). The SLR about SC is still very rare. The SLR focused on SC totaled seventh articles (by searching using "sustainability competence" AND review" in the Scopus database). SLR relates to an assessment of key SC (Annelin & Boström, 2022), human competencies (Galleli et al., 2020), and the urgency of green skills and SC (Montanari et al., 2023). So far, only two SLR-based articles have been found that are related to higher education, i.e. about service-learning as a niche innovation for sustainability (A Álvarez-Vanegas et al., 2024) and connecting competencies and pedagogical approaches (Lozano et al., 2017). Thus, it can be said that no SLR has been found that focuses on SC and university.

This study aims to analyze the efforts by universities to promote sustainability competence over the last few decades and it is anticipated that it will make a valuable contribution to the advancement of literacy studies about ESD. The outcomes of the data extraction process regarding the extent of scholarly investigations on SC in academic institutions globally will offer insights into the existing level of emphasis and endorsement for these subjects. Consequently, this SLR introduces a unique perspective in the realm of scholarly inquiry centered around higher education.

Research Method

This investigation constitutes SLR, a methodological approach designed to systematically identify, assess, and analyze all pertinent research findings about specific research inquiries, topics, or areas of interest (Chigbu et al., 2023). Independent study, also known as individual study, constitutes a fundamental form of research, whereas a systematic review represents a secondary level of investigation. This study used a qualitative approach with a systematic literature review adopted from Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA), in inclusion and exclusion refers to Page et al (2021), which consists of four stages, namely identification, screening, eligibility, and inclusion (Selcuk, 2019).

The research question was what are the publication trends and efforts by universities to promote sustainable competence over the last few decades? We use the words "sustainability competence" in the disbursement menu in the Scopus database. Data simulation used "Analyze search results" provided by Scopus. To enrich data and analysis, we exported the data in *CSV format (for visualizing data process with VOSviewer) and *RIS (for synchronized with Mendeley). The search yielded 146 articles, so they needed to be filtered (inclusion and exclusion) to focus the analysis. The sequence of inclusion and exclusion is shown in Figure 1.

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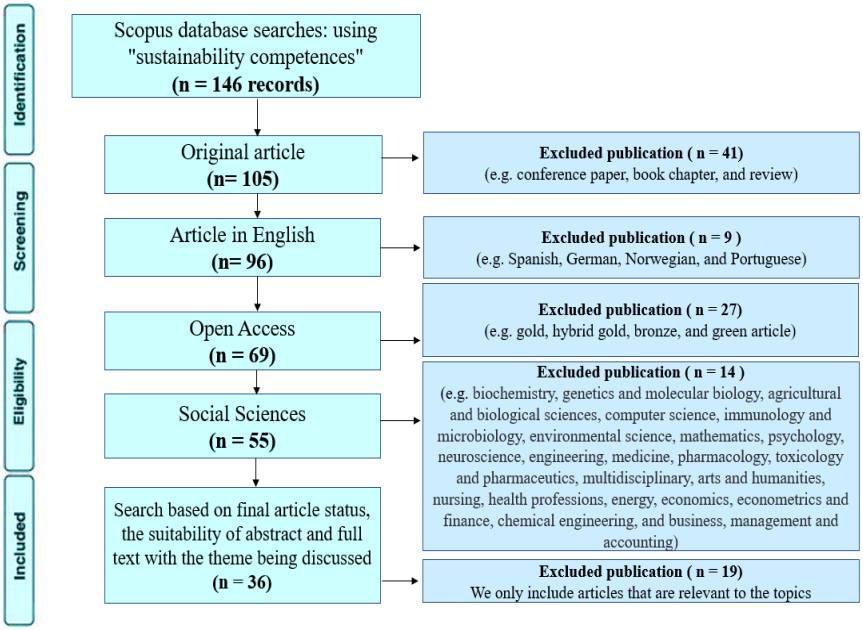

Figure 1. PRISMA flow diagram

Figure 1 shows that in the initial search, we found a total of 146 articles. At the end of the PRISMA process, we got 36 final articles that were suitable, which means 19 articles were excluded. We conducted a content analysis in this SLR. Combining a SLR with content analysis in scientific research provides numerous advantages. It enables a thorough comprehension of the current knowledge base about a specific subject, as demonstrated in the examination of exchange rate misalignment and its prominent authors.

Results and Discussion

Document by year

Figure 2 shows the number of articles in the Scopus database, annually from 2009 to 2024. It can be seen that the trend of publications on SC and higher education tends to increase from 2020 to 2023. The issue of SC began to receive attention in 2009, although in aggregate it has become the focus since 2018. We can see that during the COVID-19 pandemic, SC as part of the SDGs issue received more attention than researchers in universities. And this trend will continue to increase until post-pandemic (2022-2023). We cannot yet conclude the data for 2024 considering that this data still reaches April 2024.

Research in higher education during and after the COVID-19 pandemic has highlighted the importance of SC themes (Salem et al., 2023). The pandemic has necessitated a transformation in higher education institutions towards sustainability, digitalization and resilience (Liu & Li, 2023). Various studies emphasize the need for integrating technology in ESD, with a focus on educators who are familiar with digital technologies (Shishakly et al., 2024). Various studies have successfully identified strategies for dealing with post-pandemic uncertainty, emphasizing resilience, change management, digital transformation, and curriculum change as key dimensions for sustainability in higher education (Qureshi et al., 2024). The evolving higher education landscape post-COVID-19 underscores the need for practice and SC to anticipate the various challenges that may occur in the future (Jacques et al., 2023).

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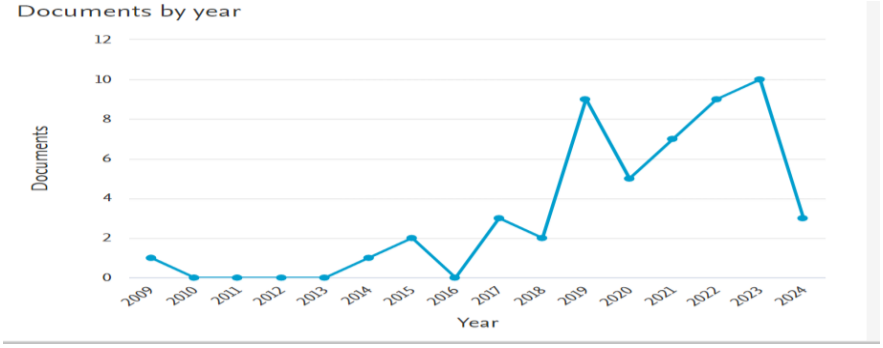

Figure 2. documents by year

Author's country or territory and Funding Sponsor

The trend of author's country or territory of research related to "sustaianbility competence and universities" themes are presented in Figure 3.

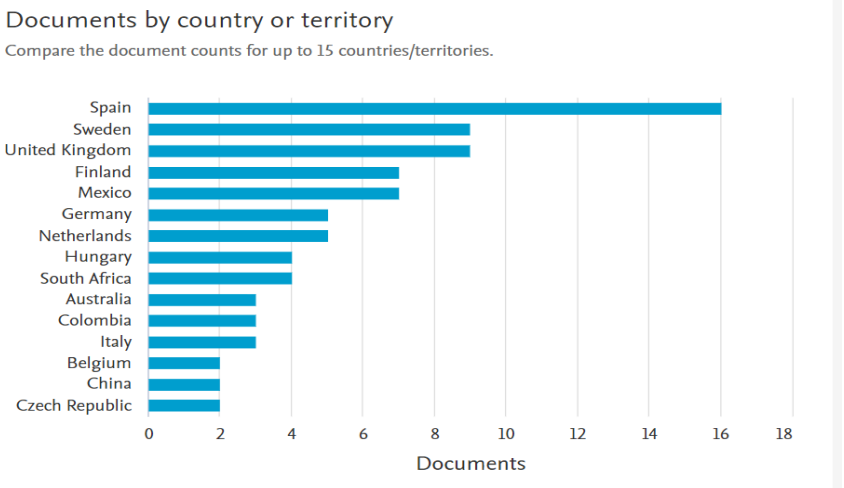

Figure 3. Author's country or territory

Based on Figure 3, it can be seen that there are 15 countries where the authors come from, dominated by countries on the European continent, namely Spain, Sweden, United Kingdom, Finland, Germany, Netherlands, Hungary, Italy, Belgium and Czech Republic. Meanwhile, the only other countries are Mexico (America), South Africa (Africa) and China (Asia). This fact is also supported by the concern of funding sponsors from Europe in funding research and publications regarding sustainability competence (see Figure 4). Thus, the theme of SC is still an issue that is the focus of European countries. This theme, therefore, needs to be campaigned widely on other continents, especially Asia, Africa, Oceania and America because its role and position are also important in terms of sustainability.

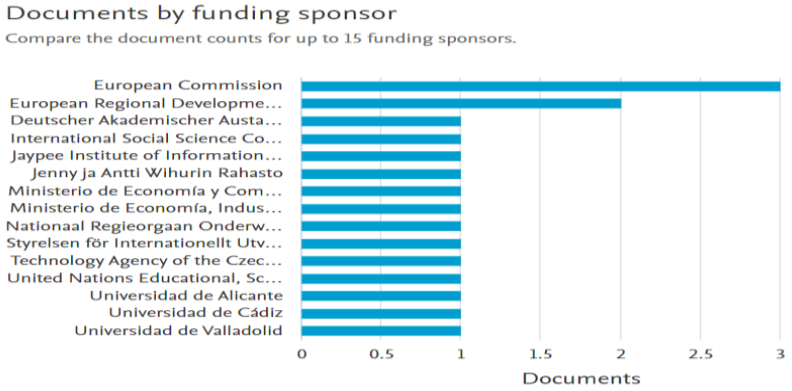

Figure 4. Funding sponsor

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The concept of sustainability and the acquisition of sustainability competencies have emerged as a predominant focal point within European higher education institutions and European funding sponsors due to a myriad of contributing factors. Europe boasts a rich historical background concerning environmental preservation and sustainable growth, primarily steered by an acknowledgment of the finite nature of natural resources and the adverse ramifications of pollution and environmental deterioration (Aydin et al., 2023). The European Union has enforced robust regulations and endeavors aimed at fostering sustainable development, exemplified by initiatives like the Green Deal (Koundouri et al., 2024). Hence, European academic institutions are actively addressing these imperatives by enhancing sustainability-related academic programs and scholarly investigations, equipping forthcoming cohorts with the requisite comprehension and aptitudes to confront global predicaments.

Conceptual and practical implications (based on research concern and keywords trend)

We can formulate conceptual and practical implications based on research concerns and keyword trends, as presented in Table 1 and Figure 5. The trend of research concern or being promoted related to "sustainability competence and universities" themes is presented in Table 1. Table 1 shows that various efforts have been made by universities in the world to promote SC. Their focus is on strengthening SC to realize SD or SDGs through strengthening active teaching and learning, strengthening students and teachers, and reformulating and adapting the curriculum at the tertiary level. This is very much in line with the keyword trend resulting from simulations with VOSviewer, as presented in Figure 5. Figure 5 shows that the word/phrase Sustainable Development is related to sustainability competence, and higher education (as the dominant phrase). These phrases then branch out and are related to teaching, active learning, students, teachers, and curriculum

Table 1. Research concern or being promoted

No	Reference	Important aspects that are of concern/promoted
1	(Segalàs et al., 2009)	This article aims to identify and promote research on essential sustainability skills for undergraduate engineering students at three technical institutions using European Higher Education Area descriptors.
2	(Ull et al., 2014)	A study examined educators' perceptions on integrating sustainability concepts into courses, revealing their stance on fostering essential SC.
3	(Besong & Holland, 2015)	This article presents the Dispositions, Abilities, and Behaviours (DAB) framework, which shaped the development of an intervention in the years 2013-2014 aimed at assessing SC in graduating undergraduate students at a university establishment.
4	(Gardiner & Rieckmann, 2015)	The University of Vechta in Germany implemented a course, "Sustainability and the Future," as part of action research on essential sustainability skills in higher education, using reflective journaling to explore competency acquisition.
5	(Lambrechts et al., 2017)	The article examines professional development initiatives focused on sustainability at a higher education institution, offering insights on organizational change and enhancing these initiatives to better integrate sustainability skills.
6	(Keeler et al., 2018)	This study analyzes five city-university collaborations in three countries, revealing that understanding motivations, sustainability measures, and skills in both city administration and universities aids in spreading sustainable solutions.
7	(Zhou et al., 2019)	This paper introduces collaborative learning by teaching (CLBT), a learner-focused strategy. It investigates student attitudes towards CLBT through an empirical study at a Chinese state university.
8	(Dlouhá et al., 2019)	The tool's examination of SC shows a transformation continuum from holistic reasoning to future focus and the synergy between individual and systemic competencies. The evaluated models balance both dimensions, especially socio-emotional competencies linked to envisioning and achieving sustainable transformation.
9	(Rubio et al., 2019)	Primary findings reveal that humanities and engineering courses, along with degree projects, effectively foster comprehensive and introspective methodologies. However, environmental issues are lacking in Informatics Engineering, and ethical dilemmas are absent in Industrial Engineering curricula.
10	(Shephard et al., 2019)	The study detailed in this article delves into the potential for miscommunication or misinterpretation of fundamental principles in these disciplines to impede advancements towards their goals.

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No	Reference	Important aspects that are of concern/promoted
11	(Alexa et al., 2020)	This study aimed to examine how Romanian technical universities integrate sustainability skill courses into their engineering curricula. Results showed varied implementation across universities and even within faculties, suggesting a fragmented approach to sustainability education.
12	(Ayers, 2020)	This study investigates the Engineers without Borders Design Summit's impact on developing sustainability skills. It suggests that contextualization, like employing sustainability principles as constraints, engaging with sustainability-oriented mentors, and confronting unsustainable practices, enhances individual commitment to sustainability.
13	(Finnveden et al., 2020)	Higher education institutions (HEIs) in Sweden are mandated, in accordance with the provisions of the Higher Education Act, to advocate for sustainable development (SD). This empirical investigation stands out as an exceptional analysis encompassing all HEIs within a nation.
14	(Solís-Espallargas & Morón-Monge, 2020)	The findings demonstrate enhancements in the attainment of these skills, stemming not solely from self-assessment but also from the research approach undertaken within this novel endeavor. Similarly, these outcomes suggest the efficacy of the pedagogical recommendation as a potential educational approach for upholding the continuity of the science education curriculum.
15	(Napal et al., 2020)	While initially designed for the purpose of filtering multimedia materials within an educational setting, this tool (along with the indicators included) has the potential to be applied to the curation and organization of diverse resources and tasks, ultimately identifying those that enhance the development of scientific skills.
16	(Urrea-Solano et al., 2021)	Based on the findings, the participants enrolled in the Bachelor's program in Early Childhood Education exhibited a superior proficiency in e-sustainable competence, particularly in the areas of general skills and the economic aspect of digital sustainability.
17	(Moreno-Pino et al., 2021)	The worldwide findings indicate a significant dearth of sustainability competencies within the field of Mathematics Education, with merely 25% presence, particularly noting that ethical competencies exhibit the lowest relative presence at 10%.
18	(Membrillo-Hernández et al., 2021)	Researchers proposed definition for the sustainability transversal competence is: "The student possesses the knowledge, skills and attitudes necessary for the successful performance of the task and the resolution of problems related to the challenges and opportunities for sustainability in today's world".
19	(Scharenberg et al., 2021)	Multilevel analyses revealed that, on an individual level, prerequisites of previous knowledge alongside characteristics related to ESD, such as students' engagement in activities and overall understanding of sustainability, emerged as the most influential factors in their progress. Furthermore, distinctions specific to grades and academic tracks were noted.
20	(Fodor et al., 2021)	Novel methodologies offered here can shift focus towards sustainable development, helping curriculum developers and policymakers assess labor market demands for sustainability-related skills. The outcomes could form the basis for developing training programs and teaching materials with clear learning objectives.
21	(Lucas Mangas et al., 2021)	The findings indicate that despite the absence of statistically significant discrepancies in the pre-test and post-test measurements, there is a discernible inclination towards enhancing personal norms regarding sustainable development.
22	(Asikainen & Tapani, 2021)	This study delves into the cognitive process of teacher candidates as they interpret sustainable development and the intersection between adopting ESD in their teaching practice and entrepreneurial endeavors. The findings suggest that there is potential for profound learning experiences.
23	(Kioupi & Voulvoulis, 2022)	Researchers demonstrate the utilization of the evaluation instrument in a case study conducted at a University, and we formulate deductions regarding the insights it provides into how professionals in higher education can leverage its utilization.
24	(Wang et al., 2022)	The findings show that universal pedagogical approaches correlate with cultivating students' sustainability mindset and engagement in sustainability actions. Moreover, enhancing students' sustainability mindset directly influences their endorsement of the new environmental paradigm and pro-environmental behaviors.
25	(Zhong et al., 2022)	The document provides results from a self-reflective practitioner-as-researcher action research carried out collaboratively by the educators of case studies.
26	(Cruz-Iglesias et al., 2022)	This methodology for designing a curriculum has the potential to motivate other educational settings and scenarios in addressing the task of conceptualizing their pathway for developing sustainable competencies.
27	(Lozano, Bautista-Puig, et al., 2022)	The study examines the importance of cultivating a sustainability competences paradigm through the promotion of sustainability education, utilization of pedagogical strategies, and enhancement of competences. It is essential to acknowledge and tackle the obstacles in order to prevent the emergence of a futile endeavor.
28	(Lozano,	The integration of sustainability into educational frameworks, as elucidated through the

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No	Reference	Important aspects that are of concern/promoted
	Barreiro-Gen, et al., 2022)	incorporation of innovative practices, offers insight into the cultivation of competencies via pedagogical methodologies. The purpose of this study is to examine this phenomenon within the context of academic disciplines.
29	(Cano García & Lluch Molins, 2022)	Higher educational institutions ought to advocate for the development of sustainability skills in their graduates as a result of its significance, a point that has been underscored amidst the pandemic. Nonetheless, there appears to be a waning emphasis on this aspect, evident in both the curriculum and the discourse among educators and students.
30	(Singh-Pillay, 2023)	The results suggest that when pre-service technology teachers (PSTTs) are encouraged to engage actively in sustainability issues within their communities, they are more likely to make well-informed decisions regarding their future role as educators, the instructional methods they intend to utilize, and the types of knowledge they aim to cultivate in students.
31	(Lozano et al., 2023)	Regression analysis identified Universal and Social categories as most effective for enhancing all competence groups. This led to the creation of the Sustainability Teaching System (STS), categorizing and illustrating pedagogical methods and sustainability competences for better comprehension.
32	(García-Alonso et al., 2023)	This study examines the influence of a mathematics instructional scheme that enhances the creation of assignments on the subjects of mathematics and sustainability, particularly emphasizing ESD.
33	(Alejandro Álvarez-Vanegas et al., 2023)	The results indicate that educators possess a certain level of understanding regarding ESD. Nevertheless, there exists a need for enhancement, especially concerning implementation. Furthermore, discrepancies emerge between the skills they strive to cultivate in their students and those they currently hold.
34	(Kadji-Beltrán, 2024)	The results demonstrate that the participants exhibited a sense of confidence and effectiveness in delivering instruction on sustainability. They also enhanced their understanding of content, pedagogy, motivation, and willingness as a result of a profound sense of duty and accountability.
35	(Cuevas-Cancino et al., 2024)	Traditional education falls short in tackling environmental challenges, necessitating scholars, institutions, and policymakers to establish and implement educational policies and strategies for a sustainable future for both humanity and the planet.
36	(Vesala-Varttala et al., 2024)	The researchers focus on three blended intensive programs in Finland and Hungary to study the impact of integrating project-based digital storytelling with reflective writing on students' sustainability competence during and after the pandemic.

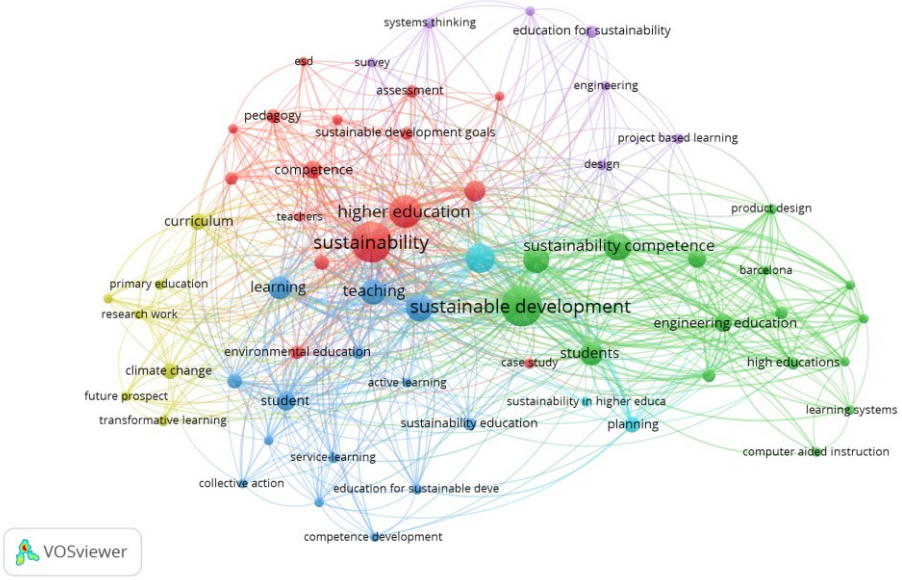

Figure 5. VOS-viewer display for type of analysis "Co-occurrence ✇keywords"

Sustainable development entails the overarching objective of attaining equilibrium among economic advancement, social fairness, and environmental safeguarding to fulfill current needs without jeopardizing the potential of forthcoming generations to fulfill their requirements (Zhao & Fariñas, 2023). Sustainability competence pertains to the knowledge, skills, and attitudes essential for individuals and entities to effectively contribute to

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sustainable development (Laasch et al., 2023). The realm of higher education assumes a pivotal role in cultivating sustainability competence through the incorporation of sustainability tenets across various fields of study, provision of specialized educational programs, encouragement of research on sustainability dilemmas, and cultivation of principles related to environmental stewardship and societal accountability among both students and faculty members (Husamah et al., 2022). Using higher education, individuals can amass the requisite proficiencies to tackle intricate sustainability challenges and evolve into catalysts of constructive transformation within their communities and beyond (Žalėnienė & Pereira, 2021).

The correlation between active learning, students, teachers, and the curriculum is crucial for achieving sustainability. Active learning methods enable students to directly engage in their education, fostering a deeper understanding of sustainability issues. (Alam & Mohanty, 2023; Smeplass, 2023). Teachers assume a crucial role in establishing a conducive learning setting, fostering inclusive dialogues, and promoting cooperative learning approaches that empower students to connect sustainability principles with their encounters (Quintero-Angel et al., 2024). An integrated curriculum with sustainability principles ensures subjects aren't taught in isolation but are embedded within relevant contexts, reinforcing students' understanding of the interconnectedness of economic, social, and environmental aspects of sustainability. (Mondragon et al., 2023).

Conclusion

This review found that sustainability competence (SC) gained attention in the Scopus database from 2009, with a notable increase during and after the COVID-19 pandemic (2020-2023). Universities globally are enhancing SC through active learning, student-teacher empowerment, and curriculum adaptation. European countries, particularly Spain, Sweden, and England, lead in research, supported by European funding. The theme should be promoted more widely, especially in Asia, Africa, Oceania, and America, due to its vital role in sustainability.

Recommendation

We can provide recommendations that university leaders and higher education policy makers (government) are advised to strengthen SC through active integration into the curriculum and innovative learning methods/models. International collaboration and wider funding support, especially on the continents of Asia, Africa, Oceania, and America, need to be pursued by the relevant parties. This is important as a concrete effort to expand the reach and impact of SC and ESD implementation in achieving the SDGs.

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References

Alam, A., & Mohanty, A. (2023). Educational technology: Exploring the convergence of technology and pedagogy through mobility, interactivity, AI, and learning tools. *Cogent Engineering*, *10*(2), 2283282. https://doi.org/10.1080/23311916.2023.2283282

Alexa, L., Maier, V., Serban, A., & Craciunescu, R. (2020). Engineers changing the world:

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Education for sustainability in Romanian technical universities-an empirical web-based content analysis. *Sustainability (Switzerland)*, *12*(5), 1983. https://doi.org/10.3390/su12051983

Álvarez-Vanegas, A, Ramani, S. V, & Volante, L. (2024). Service-Learning as a niche innovation in higher education for sustainability. *Frontiers in Education*, *9*, 1291669. https://doi.org/10.3389/feduc.2024.1291669

Álvarez-Vanegas, Alejandro, Rieckmann, M., Lopera Pérez, M., & Aguirre, P. M. (2023). Teaching with A Rounder Sense of Purpose: a survey study on education for sustainable development competences in Latin America. *Frontiers in Education*, *8*(January), 1–14. https://doi.org/10.3389/feduc.2023.1205478

Annelin, A., & Boström, G.-O. (2022). An assessment of key sustainability competencies: a review of scales and propositions for validation. *International Journal of Sustainability in Higher Education*, *24*(9), 53–69. https://doi.org/10.1108/IJSHE-05-2022-0166

Asikainen, E., & Tapani, A. (2021). Exploring the connections of education for sustainable development and entrepreneurial education—A case study of vocational teacher education in Finland. *Sustainability (Switzerland)*, *13*(21), 11887. https://doi.org/10.3390/su132111887

Aydin, M., Sogut, Y., & Altundemir, M. E. (2023). Moving toward the sustainable environment of European Union countries: Investigating the effect of natural resources and green budgeting on environmental quality. *Resources Policy*, *83*, 103737. https://doi.org/10.1016/j.resourpol.2023.103737

Ayers, J. (2020). Competence literate but context lacking? Investigating the potential of study abroad programs to promote sustainability competence acquisition in students. *Sustainability (Switzerland)*, *12*(13), 5889. https://doi.org/10.3390/su12135389

Besong, F., & Holland, C. (2015). The dispositions, abilities and behaviours (DAB) framework for profiling learners' sustainability competencies in higher education. *Journal of Teacher Education for Sustainability*, *17*(1), 5–22.

Bianchi, G. (2020). *Sustainability competences: A systematic literature review*. Publications Office of the European Union.

Cano García, E., & Lluch Molins, L. (2022). Competence-based assessment in higher education during COVID-19 lockdown: The demise of sustainability competence. *Sustainability (Switzerland)*, *14*(15), 9560. https://doi.org/10.3390/su14159560

Chigbu, U. E., Atiku, S. O., & Du Plessis, C. C. (2023). The science of literature reviews: searching, identifying, selecting, and synthesising. *Publications*, *11*(1). https://doi.org/10.3390/publications11010002

Cruz-Iglesias, E., Gil-Molina, P., & Rekalde-Rodríguez, I. (2022). A navigation chart for sustainability for the Ocean i3 educational project. *Sustainability (Switzerland)*, *14*(8), 1–16. https://doi.org/10.3390/su14084764

Cuevas-Cancino, M. de la O., Peña-Becerril, M., Mondragon-Estrada, E., & Camacho-Zuñiga, C. (2024). Incorporating vertical collaboration to address sustainable development goals: the Monarch Route Project. *Frontiers in Education*, *9*(January), 1–11. https://doi.org/10.3389/feduc.2024.1246889

Dlouhá, J., Heras, R., Mulà, I., Salgado, F. P., & Henderson, L. (2019). Competences to address SDGs in higher education-a reflection on the equilibrium between systemic and personal approaches to achieve transformative action. *Sustainability (Switzerland)*, *11*(13). https://doi.org/10.3390/su11133664

Finnveden, G., Friman, E., Mogren, A., Palmer, H., Sund, P., Carstedt, G., Lundberg, S.,

Copyright © 2024, The Author(s)

Robertsson, B., Rodhe, H., & Svärd, L. (2020). Evaluation of integration of sustainable development in higher education in Sweden. *International Journal of Sustainability in Higher Education*, *21*(4), 685–698. https://doi.org/10.1108/IJSHE-09-2019-0287

Fodor, S., Szabó, I., & Ternai, K. (2021). Competence-oriented, data-driven approach for sustainable development in university-level education. *Sustainability (Switzerland)*, *13*(17), 9977. https://doi.org/10.3390/su13179977

Galleli, B., Hourneaux, F., & Munck, L. (2020). Sustainability and human competences: a systematic literature review. *Benchmarking*, *27*(7), 1981–2004. https://doi.org/10.1108/BIJ-12-2018-0433

García-Alonso, I., Sosa-Martín, D., & Trujillo-González, R. (2023). Assessing sustainability competencies present in class proposals developed by prospective mathematics teachers. *Avances de Investigacion En Educacion Matematica*, *23*, 61–83. https://doi.org/10.35763/aiem23.5419

Gardiner, S., & Rieckmann, M. (2015). Pedagogies of preparedness: Use of reflective journals in the operationalisation and development of anticipatory competence. *Sustainability (Switzerland)*, *7*(8), 10554–10575. https://doi.org/10.3390/su70810554

Husamah, H., Suwono, H., Nur, H., & Dharmawan, A. (2022). Sustainable development research in Eurasia Journal of Mathematics, Science and Technology Education: A systematic literature review. *Eurasia Journal of Mathematics, Science and Technology Education*, *18*(5), em2103. https://doi.org/10.29333/ejmste/11965

Jacques, S., Ouahabi, A., & Kanetaki, Z. (2023). Post-COVID-19 education for a sustainable future: challenges, emerging technologies and trends. In *Sustainability* (Vol. 15, Issue 8, p. 6487). https://doi.org/10.3390/su15086487

Kadji-Beltrán, C. (2024). Enhancing sustainability teaching competence in preschool teacher education using living labs. *Sustainability (Switzerland)*, *16*(7), 2781. https://doi.org/10.3390/su16072781

Keeler, L. W., Beaudoin, F. D., Lerner, A. M., John, B., Beecroft, R., Tamm, K., Wiek, A., & Lang, D. J. (2018). Transferring sustainability solutions across contexts through city-university partnerships. *Sustainability (Switzerland)*, *10*(9), 1–17. https://doi.org/10.3390/su10092966

Kioupi, V., & Voulvoulis, N. (2022). The contribution of higher education to sustainability: The development and assessment of sustainability competences in a university case study. *Education Sciences*, *12*(6), 406. https://doi.org/10.3390/educsci12060406

Koundouri, P., Alamanos, A., Plataniotis, A., Stavridis, C., Perifanos, K., & Devves, S. (2024). Assessing the sustainability of the European Green Deal and its interlin kages with the SDGs. *Npj Climate Action*, *3*(1), 1–10.

Laasch, O., Moosmayer, D. C., & Antonacopoulou, E. P. (2023). The interdisciplinary responsible management competence framework: An integrative review of ethics, responsibility, and sustainability competences. *Journal of Business Ethics*, *187*(4), 733–757. https://doi.org/10.1007/s10551-022-05261-4

Lambrechts, W., Verhulst, E., & Rymenams, S. (2017). Professional development of sustainability competences in higher education: The role of empowerment. *International Journal of Sustainability in Higher Education*, *18*(5), 697–714. https://doi.org/10.1108/IJSHE-02-2016-0028

Lenhart, C., & Bouwma-Gearhart, J. (2022). Engaging Students around the complex socioscientific issue of sustainability: Affordances and tensions of faculty working across disciplines to develop transdisciplinary curricula. *CBE Life Sciences*

Copyright © 2024, The Author(s)

Education, *21*(2), 1–18. https://doi.org/10.1187/CBE.21-03-0075

Liu, Y., & Li, Z. (2023). International research review and teaching improvement measures of college students' learning psychology under the background of COVID-19. *Sustainability*, *15*(9), 7459. https://doi.org/10.3390/su15097459

Lozano, R., Barreiro-Gen, M., D'Amato, D., Gago-Cortes, C., Favi, C., Martins, R., Monus, F., Caeiro, S., Benayas, J., Caldera, S., Bostanci, S., Djekic, I., Moneva, J. M., Sáenz, O., Awuzie, B., & Gladysz, B. (2023). Improving sustainability teaching by grouping and interrelating pedagogical approaches and sustainability competences: Evidence from 15 Worldwide Higher Education Institutions. *Sustainable Development*, *31*(1), 349–359. https://doi.org/10.1002/sd.2396

Lozano, R., Barreiro-Gen, M., Pietikäinen, J., Gago-Cortes, C., Favi, C., Jimenez Munguia, M. T., Monus, F., Simão, J., Benayas, J., Desha, C., Bostanci, S., Djekic, I., Moneva, J. M., Sáenz, O., Awuzie, B., & Gladysz, B. (2022). Adopting sustainability competence-based education in academic disciplines: Insights from 13 higher education institutions. *Sustainable Development*, *30*(4), 620–635. https://doi.org/10.1002/sd.2253

Lozano, R., Bautista-Puig, N., & Barreiro-Gen, M. (2022). Developing a sustainability competences paradigm in Higher Education or a White Elephant? *Sustainable Development*, *30*(5), 870–883. https://doi.org/10.1002/sd.2286

Lozano, R., Merrill, M. Y., Sammalisto, K., Ceulemans, K., & Lozano, F. J. (2017). Connecting competences and pedagogical approaches for sustainable development in higher education: A literature review and framework proposal. *Sustainability (Switzerland)*, *9*(10). https://doi.org/10.3390/su9101889

Lucas Mangas, S., Marbán Prieto, J. M., Unanue Cuesta, M. C., Manso Argüelles, M. Á., & Romay Martínez, J. (2021). The role personal responsibility norms play in sustainable development for university students: The impact of service-learning projects. *Sustainability (Switzerland)*, *13*(13), 7330. https://doi.org/10.3390/su13137330

Membrillo-Hernández, J., Lara-Prieto, V., & Caratozzolo, P. (2021). Sustainability: A public policy, a concept, or a competence? efforts on the implementation of sustainability as a transversal competence throughout higher education programs. *Sustainability (Switzerland)*, *13*(24), 13989. https://doi.org/10.3390/su132413989

Mondragon, N. I., Yarritu, I., Saez de Cámara, E., Beloki, N., & Vozmediano, L. (2023). The challenge of education for sustainability in higher education: key themes and competences within the University of the Basque Country. *Frontiers in Psychology*, *14*, 1158636. https://doi.org/10.3389/fpsyg.2023.1158636

Montanari, S., Agostini, E., & Francesconi, D. (2023). Are We talking about green skills or sustainability competences? A scoping review using scientometric analysis of two apparently similar topics in the field of sustainability. *Sustainability (Switzerland)*, *15*(19), 14142. https://doi.org/10.3390/su151914142

Moreno-Pino, F. M., Jiménez-Fontana, R., Domingo, J. M. C., & Goded, P. A. (2021). Study of the presence of sustainability competencies in teacher training in mathematics education. *Sustainability (Switzerland)*, *13*(10), 5629. https://doi.org/10.3390/su13105629

Napal, M., Mendióroz-Lacambra, A. M., & Peñalva, A. (2020). Sustainability teaching tools in the digital age. *Sustainability (Switzerland)*, *12*(3366), 1–14. https://doi.org/10.3390/SU12083366

Quintero-Angel, M., Duque-Nivia, A. A., & Molina-Gómez, C. A. (2024). A teaching strategy based on active learning which promotes strong sustainability that empowers

Copyright © 2024, The Author(s)

students to have a different type of relationship with the environment. *Environmental Education Research*, *30*(4), 560–579. https://doi.org/10.1080/13504622.2023.2211757

Qureshi, F., Khawaja, S., Pejić Bach, M., & Meško, M. (2024). Slovenian higher education in a post-pandemic world: Trends and transformations. *Systems*, *12*(4). https://doi.org/10.3390/systems12040132

Rubio, R. M., Uribe, D., Moreno-Romero, A., & Yáñez, S. (2019). Embedding sustainability competences into engineering education. The case of informatics engineering and industrial engineering degree programs at Spanish universities. *Sustainability (Switzerland)*, *11*(20), 5832. https://doi.org/10.3390/su11205832

Salem, I. E., Abbas, H. F., Akram, H. W., & Elbaz, A. M. (2023). Contemporary sustainability themes in tourism and hospitality during and post COVID-19: Critical review and a step strategies forward for post the pandemic. *Sustainable Development*. https://doi.org/10.1002/sd.2636

Scalabrino, C. (2022). *European sustainability competence framework background document - Literature Review, Analysis of Frameworks and Proposals*. Publications Office of the European Union. https://doi.org/10.2760/378627

Scharenberg, K., Waltner, E. M., Mischo, C., & Rieß, W. (2021). Development of students' sustainability competencies: Do teachers make a difference? *Sustainability (Switzerland)*, *13*(22), 1–22. https://doi.org/10.3390/su132212594

Segalàs, J., Ferrer-Balas, D., Svanström, M., Lundqvist, U., & Mulder, K. F. (2009). What has to be learnt for sustainability? A comparison of bachelor engineering education competences at three European universities. *Sustainability Science*, *4*(1), 17–27. https://doi.org/10.1007/s11625-009-0068-2

Shephard, K., Rieckmann, M., & Barth, M. (2019). Seeking sustainability competence and capability in the ESD and HESD literature: an international philosophical hermeneutic analysis. *Environmental Education Research*, *25*(4), 532–547. https://doi.org/10.1080/13504622.2018.1490947

Shishakly, R., Almaiah, M. A., Lutfi, A., & Alrawad, M. (2024). The influence of using smart technologies for sustainable development in higher education institutions. *International Journal of Data and Network Science*, *8*(1), 77–90. https://doi.org/10.5267/j.ijdns.2023.10.015

Singh-Pillay, A. (2023). Pre-Service Teachers' Experience of Learning about Sustainability in Technology Education in South Africa. *Sustainability (Switzerland)*, *15*(3), 2149. https://doi.org/10.3390/su15032149

Smeplass, E. (2023). Nurturing inclusivity and professional growth among vocational teachers through communities of practice. *Pedagogy, Culture & Society*, *2023*, 1–20. https://doi.org/10.1080/14681366.2023.2268108

Solís-Espallargas, C., & Morón-Monge, H. (2020). How to improve sustainability competences of teacher training? Inquiring the prior knowledge on climate change in primary school students. *Sustainability (Switzerland)*, *12*(16), 1–17. https://doi.org/10.3390/su12166486

Ull, M. A., Piñero, A., Martínez Agut, M. P., & Aznar Minguet, P. (2014). Preconcepcions and attitudes of teachers of Teaching School about incorporated sustainability competences in their teaching. *Enseñanza de Las Ciencias. Revista de Investigación y Experiencias Didácticas*, *32*(2), 91–112. https://doi.org/10.5565/rev/ensciencias.904

Urrea-Solano, M., Hernández-Amorós, M. J., Merma-Molina, G., & Baena-Morales, S. (2021). The learning of e-sustainability competences: A comparative study between

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future early childhood and primary school teachers. *Education Sciences*, *11*(10), 644. https://doi.org/10.3390/educsci11100644

Vesala-Varttala, T., Pál, Á., & Kóris, R. (2024). Fostering sustainability competences through co-creation of digital storytelling: Effects of COVID-19 on higher education students' reflective learning. *Journal of University Teaching and Learning Practice*, *21*(3), 1–26. https://doi.org/10.53761/3va1xt56

Wang, Y., Sommier, M., & Vasques, A. (2022). Sustainability education at higher education institutions: Pedagogies and students' competences. *International Journal of Sustainability in Higher Education*, *23*(8), 174–193. https://doi.org/10.1108/IJSHE-11-2021-0465

Žalėnienė, I., & Pereira, P. (2021). Higher education for sustainability: A global perspective. *Geography and Sustainability*, *2*(2), 99–106. https://doi.org/https://doi.org/10.1016/j.geosus.2021.05.001

Zhao, J., & Fariñas, B. G. (2023). Artificial intelligence and sustainable decisions. *European Business Organization Law Review*, *24*(1), 1–39. https://doi.org/10.1007/s40804-022-00262-2

Zhong, Z., Feng, F., Li, J., Liu, X., Cao, Y., & Liao, Y. (2022). Making university and curricular sustainable entrepreneurship: a case study of Tsinghua University. *Asia Pacific Education Review*, *23*(4), 559–569. https://doi.org/10.1007/s12564-022-09797-y

Zhou, X., Chen, L. H., & Chen, C. L. (2019). Collaborative learning by teaching: A pedagogy between learner-centered and learner-driven. *Sustainability (Switzerland)*, *11*(4), 1174. https://doi.org/10.3390/su11041174

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