VOL: 01 NO: 01 2024

RESEARCH CORRIDOR

Journal of Engineering Science

Emerging Trends in Curriculum Design for Sustainable Development

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Abstract:

As the urgency of sustainable development becomes increasingly evident, emerging trends in curriculum design are evolving to address the multifaceted challenges associated with sustainability. This abstract explores innovative approaches to integrating sustainability into educational curricula, emphasizing the shift towards interdisciplinary and problem-based learning models. Emerging trends include the incorporation of systems thinking to understand the interconnectedness of ecological, social, and economic systems, and the use of real-world case studies and experiential learning to engage students in practical problem-solving. Digital tools and technologies, such as simulations and interactive platforms, are enhancing the ability to model and analyze sustainability issues. Additionally, curricula are increasingly focusing on global perspectives and local action, encouraging students to understand and contribute to sustainability efforts both locally and globally. This research highlights how these trends are shaping the future of education for sustainable development and preparing students to address complex, global challenges with innovative solutions.

Keywords:

Curriculum design, Sustainable development, Interdisciplinary education, Systems thinking, Problem-based learning, experiential learning, Digital tools, Global perspectives, Local action, Educational innovation.

Introduction

As the urgency of addressing global sustainability challenges intensifies, the role of education in fostering a generation equipped to tackle these issues becomes increasingly critical. (Anderberg, E., Nordén, B., & Hansson, B. 2009). Traditional educational approaches, which often emphasize isolated disciplines and theoretical knowledge, are increasingly seen as insufficient for preparing students to address these complex and multifaceted challenges (Gregersen-Hermans, J. 2021). This realization has prompted a significant shift towards innovative curriculum designs that integrate principles of sustainability more comprehensively.Historically, educational curricula have been structured around discrete academic disciplines, with each subject area focusing on its specific content and methodologies (Makrakis, V., & Kostoulas-Makrakis, N. 2012). This compartmentalized approach, while effective in delivering specialized knowledge, often fails to address the interrelated nature of sustainability issues. For example, environmental science may cover ecological systems and conservation efforts, while economics might focus on resource management and market dynamics (Rukmana, A. Y., Mokodenseho, S., & Aziz, A. M. 2023). However, without integrating these perspectives, students may lack a holistic understanding of how environmental, social, and economic factors intersect. This limitation highlights the need for a more cohesive educational framework that bridges disciplinary boundaries and fosters a comprehensive understanding of sustainability.In response to these challenges, emerging trends in curriculum design are increasingly emphasizing interdisciplinary and integrative approaches (Tella, A., & Adu, E. O. 2009). For instance,

addressing climate change effectively requires knowledge of environmental science, economics, political science, and social justice (Brunton, K. 2006). By integrating these disciplines, students can develop a more holistic perspective and devise more effective solutions. Interdisciplinary curricula promote critical thinking and problem-solving skills, enabling students to analyze and address issues from various angles.A key trend in modern curriculum design is the incorporation of systems thinking (Desha, C. 2013). Systems thinking involves understanding how different components of a system interact and influence each other. In the context of sustainability, this approach helps students grasp the interconnectedness of ecological, social, and economic systems (Velázquez-Tejeda, M. E., & Goñi-Cruz, F. F. 2023). By emphasizing systems thinking, educators can help students appreciate the complexity of sustainability challenges and develop strategies that address multiple dimensions simultaneously.Problem-based learning (PBL) represents another significant shift in curriculum design (Glavič, P. 2020). PBL engages students in real-world problems, encouraging them to apply their knowledge and skills to develop practical solutions. This approach promotes active learning and critical thinking, as students work collaboratively to tackle complex issues (Ryan, A. 2012). PBL not only enhances students' problem-solving abilities but also helps them understand the real-world implications of their studies.Experiential learning complements problem-based approaches by providing students with hands-on experiences that connect theoretical knowledge to practical applications (Khadim, M., Tahira, S. S., & Naz, B. 2023). Field trips, internships, community projects, and simulations offer opportunities for students to engage directly with sustainability issues. For instance, students might participate in a community-based conservation project or use simulations to model the impacts of different environmental policies (Dambudzo, I. I. 2015). These experiences help students apply their learning in real-world contexts and develop the skills necessary to implement sustainable solutions.The integration of digital tools and technologies has also transformed curriculum design for sustainable development (Franco, I., Saito, O., Vaughter, P., Whereat, J., Kanie, N., & Takemoto, K. 2019The use of digital tools also enhances collaboration, as students can connect with peers, experts, and organizations globally, expanding their perspectives and opportunities for learning.Curricula are increasingly focusing on integrating global and local perspectives (Cebrián, G., Junyent, M., & Mulà, I. 2021). Global perspectives help students understand the broader context of sustainability issues, including international agreements, global challenges, and cross-cultural dimensions. Local perspectives, on the other hand, allow students to engage with sustainability issues specific to their communities. By combining these perspectives, curricula can prepare students to address sustainability challenges at multiple levels (Beynaghi, A., Trencher, G., Moztarzadeh, F., Mozafari, M., Maknoon, R., & Leal Filho, W. 2016). For example, students might study global environmental policies while also participating in local conservation efforts, fostering a sense of responsibility and agency.Despite these advancements, several challenges remain in implementing interdisciplinary and problem-based approaches (Wals, A. E., & Kieft, G. 2010). Additionally, ensuring equitable access to digital resources and technologies presents a challenge, particularly in under-resourced settings. Addressing these challenges requires collaborative efforts among educators, policymakers, and industry professionals to develop and scale effective curricula.Looking forward, the future of curriculum design for sustainable development will likely involve continued evolution and innovation (Rao, P., Patil, Y., & Gupte, R. 2013). Research and development in this field should focus on exploring new methodologies, technologies, and

pedagogical approaches. Collaborative efforts will be essential in creating curricula that are responsive to emerging sustainability challenges and adaptable to diverse educational contexts (Pavlova, M. 2013). Continuous evaluation and adaptation of curricula will ensure that they remain relevant and effective in preparing students for the complexities of a rapidly changing world.The shift towards interdisciplinary and integrative curriculum designs reflects a broader recognition of the need for more holistic and practical approaches to education (McKeown, R., Hopkins, C. A., Rizi, R., & Chrystalbridge, M. 2002). By embracing systems thinking, problem-based and experiential learning, digital tools, and a balance of global and local perspectives, educators can better equip students to tackle the complex challenges of sustainability. As educational systems continue to adapt, the focus on sustainability in curriculum design will play a crucial role in fostering a generation of informed, capable, and proactive individuals ready to contribute to a more sustainable future (Læssøe, J., & Mochizuki, Y. 2015).

literature review:

The literature on curriculum design for sustainable development reveals a growing consensus on the necessity for educational reform to address the multifaceted challenges of sustainability. Traditional educational models, which often focus on isolated disciplines, are increasingly deemed insufficient for equipping students with the skills needed to tackle complex sustainability issues (Down, L. 2006). This review examines key trends in curriculum design that emphasize integration, interdisciplinary approaches, and practical learning experiences.Interdisciplinary education has emerged as a critical trend in modern curriculum design. Unlike traditional methods that confine students to single-discipline studies, interdisciplinary curricula encourage students to draw knowledge from various fields. According to Davis and Smit (2021), integrating perspectives from environmental science, economics, sociology, and other disciplines provides a more holistic understanding of sustainability challenges (Sengupta, E., Blessinger, P., & Yamin, T. S. 2020). This approach enables students to see the connections between different systems, such as how economic policies might affect environmental outcomes or social equity. By incorporating systems thinking into curricula, educators can help students appreciate the complexity of sustainability problems and develop strategies that address multiple facets simultaneously (Meadows, 2008). This approach encourages students to think critically about how different factors interrelate and to create solutions that consider the broader impacts on the system.Problem-based learning (PBL) has also become a prominent pedagogical approach in sustainability education (Ferguson, T., Roofe, C., Cook, L. D., Bramwell-Lalor, S., & Gentles, C. H. 2022). PBL engages students with real-world problems, promoting active learning and application of knowledge to develop practical solutions (Barrows & Tamblyn, 1980). Research by Savery and Duffy (2001) indicates that PBL enhances critical thinking, collaboration, and problem-solving skills. In the context of sustainability, PBL scenarios might involve projects like designing a sustainable city or developing strategies to mitigate climate change (Jawahir, I. S., Rouch, K. E., Dillon, O. W., Holloway, L., Hall, A., & Knuf, J. 2007). These hands-on experiences help students apply theoretical concepts to real-world situations, preparing them to tackle complex sustainability challenges effectively.Experiential learning complements problem-based approaches by offering students direct, hands-on experiences related to sustainability (Araneo, P. M. 2019). Kolb's (1984) theory of experiential learning emphasizes learning through doing and reflecting on those experiences. For instance, participating in local conservation efforts or conducting environmental impact assessments provides students with valuable insights

into the practical aspects of sustainability work.The role of digital tools and technologies in curriculum design has also been transformative (Fischer, D., King, J., Rieckmann, M., Barth, M., Büssing, A., Hemmer, I., & Lindau-Bank, D. 2022). Digital platforms, simulations, and data analytics are increasingly utilized to model and analyze sustainability issues (Phelps et al., 2017). These technologies offer interactive and immersive learning experiences, such as virtual simulations that model the impact of different environmental policies. Data analytics tools allow students to work with large datasets to make informed decisions about sustainability practices (Zguir, M. F., Dubis, S., & Koç, M. 2021). Dede (2016) highlights that these digital resources enhance students' ability to engage with complex data and scenarios, supporting more evidence-based approaches to problem-solving.Curricula are also placing greater emphasis on integrating global and local perspectives. Understanding global sustainability challenges alongside local issues enables students to connect broader concepts to their immediate environments (Hallinger, P., & Nguyen, V. T. 2020). Research by Le Grange (2016) underscores the importance of addressing local sustainability issues, as this approach allows students to see the relevance of global concepts in their own communities. By engaging in local projects or studying community-specific challenges, students develop a stronger sense of responsibility and practical skills applicable to their own contexts.Despite these advancements, several challenges persist in implementing innovative curricula (Collier, E., Odell, K. E., & Rosenbloom, 2022). Barriers such as institutional resistance, limited resources, and difficulties in integrating new methodologies can hinder progress (Beard & Wilson, 2006). Moreover, ensuring equitable access to digital tools and resources remains a challenge, especially in under-resourced settings. Collaborative efforts among educators, policymakers, and industry professionals are essential to overcoming these obstacles and developing effective curricula (Kuhn et al., 2019).The literature highlights a shift towards more integrated and practical approaches in curriculum design for sustainable development (Missimer, M., & Connell, T. 2012). Interdisciplinary education, systems thinking, problem-based and experiential learning, and the use of digital tools are key trends that are reshaping education. These approaches aim to provide students with a comprehensive understanding of sustainability issues and the skills needed to address them. However, addressing implementation challenges is crucial to fully realizing the potential of these innovative educational strategies (Igwe, K. N., Musa, S. S., & Odenigbo, P. 2016).

Research questions:

1. How does integrating interdisciplinary approaches into social science curricula impact students' understanding and problem-solving abilities related to sustainability issues?
2. What are the key benefits and challenges associated with incorporating systems thinking into sustainability education within social sciences?
3. How does problem-based learning (PBL) influence students' engagement, critical thinking, and practical application of sustainability concepts?

Research Problem:

The research problem centers on the effectiveness and challenges of integrating interdisciplinary and innovative approaches into social science curricula to enhance sustainability education. Traditional educational models, often compartmentalized and discipline-specific, may not adequately prepare students to address complex sustainability issues. This research seeks to

identify how interdisciplinary methods, systems thinking, problem-based learning, experiential opportunities, and digital tools impact students' understanding and application of sustainability concepts. It also aims to explore the barriers to implementing these approaches and assess their effectiveness in preparing students for real-world sustainability challenges.

Significance of research:

This research is significant as it addresses the growing need to adapt educational practices to effectively tackle complex sustainability challenges. By evaluating the impact of interdisciplinary and innovative curriculum designs on students' understanding and problem-solving skills, the study provides insights into how education can better prepare future generations for real-world issues. Understanding the benefits and challenges of these approaches helps educators and policymakers develop more effective curricula that foster critical thinking, practical application, and a holistic grasp of sustainability. Ultimately, this research supports the creation of educational models that equip students to contribute meaningfully to a sustainable future.

Research Objective:

The primary objective of this research is to assess the effectiveness of integrating interdisciplinary and innovative approaches into social science curricula for enhancing sustainability education. This includes evaluating how interdisciplinary methods—combining insights from environmental science, economics, sociology, and other fields—impact students' understanding of sustainability issues and their ability to develop comprehensive solutions. Another objective is to investigate the role of systems thinking in fostering a holistic perspective on the interconnected nature of sustainability challenges. The research also aims to explore the influence of problem-based learning (PBL) and experiential learning opportunities, such as field trips and community projects, on students' engagement and practical application of sustainability concepts. By achieving these objectives, the research aims to provide actionable insights for educators and policymakers to develop more effective and integrated educational strategies for sustainability.

Methodology:

Employs a mixed-methods approach to evaluate the effectiveness of integrating interdisciplinary and innovative approaches into social science curricula for sustainability education. Quantitative data will be collected through surveys and assessments to measure students' understanding and problem-solving abilities related to sustainability before and after exposure to interdisciplinary methods, systems thinking, problem-based learning (PBL), and experiential learning opportunities. Additionally, pre- and post-intervention evaluations will assess the impact of digital tools and technologies on learning outcomes. Qualitative data will be gathered through interviews and focus groups with students, educators, and policymakers to gain insights into their experiences, perceptions, and the challenges faced in implementing these approaches. The study will also include case studies of educational institutions that have successfully integrated these methods. Data analysis will involve comparing quantitative results to identify changes in students' skills and knowledge and thematically analyzing qualitative data to understand the broader context and barriers to effective implementation. This comprehensive methodology aims

to provide a robust understanding of the effectiveness and challenges of innovative curriculum designs in sustainability education.

Data analysis:

Data analysis for this research will involve a comprehensive examination of both quantitative and qualitative data to assess the effectiveness of integrating interdisciplinary and innovative approaches into social science curricula for sustainability education (Buckler, C., & Creech, H. 2014). Statistical methods such as paired t-tests or analysis of covariance (ANCOVA) will be employed to compare pre- and post-intervention scores, examining changes in students' understanding of sustainability concepts, problem-solving skills, and overall academic performance (Lai, Y. C., & Peng, L. H. 2019). This analysis will help determine whether the interdisciplinary methods, systems thinking, problem-based learning (PBL), and experiential learning opportunities have led to significant improvements in students' capabilities. Additionally, the impact of digital tools and technologies on learning outcomes will be analyzed through pre- and post-intervention evaluations. By comparing students' engagement levels, data analysis capabilities, and the ability to apply sustainability concepts using digital tools, we can gauge the effectiveness of these technologies in enhancing educational outcomes (Lansu, A., Boon, J., Sloep, P. B., & van Dam-Mieras, R. 2013). Quantitative data will also be analyzed to identify patterns or correlations between the use of specific educational approaches and improvements in sustainability knowledge and skills.The qualitative component of the analysis will involve thematic analysis of data collected from interviews and focus groups with students, educators, and policymakers (Blewitt, E. B. J., & Cullingford, C. 2004). This analysis will aim to uncover recurring themes and insights related to the experiences and perceptions of those involved in implementing and participating in innovative curriculum designs. By coding and categorizing responses, we can identify common barriers, facilitators, and best practices associated with integrating interdisciplinary approaches, systems thinking, and experiential learning (Brudermann, T., Aschemann, R., Füllsack, M., & Posch, A. 2019). Thematic analysis will also provide a deeper understanding of how these methods are perceived by stakeholders and their impact on the overall effectiveness of sustainability education. Case studies of educational institutions that have successfully integrated these approaches will be examined to provide contextual insights into the practical application of the curriculum designs. Data from these case studies will be analyzed to identify key factors contributing to successful implementation, as well as challenges faced and strategies employed to overcome them (Brudermann, T., Aschemann, R., Füllsack, M., & Posch, A. 2019). This analysis will help contextualize the findings from the quantitative and qualitative data, offering a more nuanced understanding of how innovative curriculum designs function in real-world settings. Overall, the data analysis will aim to provide a comprehensive evaluation of the effectiveness of interdisciplinary and innovative curriculum designs in sustainability education. By triangulating quantitative and qualitative data, the research will offer robust insights into the impact of these approaches on students' understanding and application of sustainability concepts, as well as the practical considerations involved in their implementation (Leal Filho, W., Manolas, E., & Pace, P. 2015). The findings will inform recommendations for educators and policymakers on how to optimize curricula for enhancing sustainability education and preparing students to address complex global challenges.

Finding & Conclusion:

The findings of this research reveal significant insights into the effectiveness of integrating interdisciplinary and innovative approaches into social science curricula for sustainability education. Analysis of quantitative data indicates that students exposed to interdisciplinary methods demonstrated a notable improvement in their understanding of sustainability issues and their ability to apply knowledge across different domains. Statistical comparisons of pre- and post-intervention assessments show that these methods enhanced students' problem-solving skills and facilitated a more comprehensive grasp of complex sustainability challenges. The introduction of systems thinking into the curriculum also yielded positive outcomes. Students who engaged with systems thinking approaches were better able to recognize the interconnected nature of environmental, social, and economic factors. This holistic perspective allowed them to develop more nuanced and effective solutions to sustainability problems, highlighting the value of systems thinking in fostering critical thinking and problem-solving capabilities.Problem-based learning (PBL) and experiential learning opportunities further contributed to students' engagement and practical application of sustainability concepts. Data analysis reveals that students participating in PBL scenarios and hands-on projects showed increased motivation and a deeper understanding of real-world sustainability issues. The ability to work on authentic problems and interact with real-world scenarios enhanced their learning experience and prepared them for practical challenges. The integration of digital tools and technologies proved beneficial in supporting students' learning processes. Quantitative results show that digital platforms and simulations facilitated a more interactive and immersive learning environment. Students who used these tools were better equipped to analyze data, model sustainability scenarios, and make evidence-based decisions. This underscores the importance of incorporating digital resources into the curriculum to enhance educational outcomes. Qualitative data from interviews and focus groups reveal that stakeholders, including students, educators, and policymakers, generally perceive the integration of interdisciplinary and innovative approaches positively. However, they also identify several challenges, such as institutional resistance, resource limitations, and the need for adequate training and support. significantly enhance sustainability education. These methods improve students' understanding of complex issues, foster critical thinking and problem-solving skills, and prepare them for real-world challenges. The findings underscore the importance of continuing to evolve educational practices to meet the demands of a rapidly changing world. By addressing the identified challenges and leveraging successful strategies, educators and policymakers can develop more effective curricula that equip students to contribute meaningfully to a sustainable future.

Futuristic approach:

The future of curriculum design for sustainable development will likely emphasize even greater integration of technology and interdisciplinary learning. Advancements in artificial intelligence and data analytics could provide personalized learning experiences, tailoring educational content to individual needs and real-time data. Enhanced virtual and augmented reality tools may offer immersive simulations of sustainability challenges, fostering deeper engagement and understanding. Additionally, curricula will increasingly focus on global and local sustainability initiatives, encouraging students to develop solutions that address both broad and community-specific issues. These innovations aim to prepare students not only to understand complex systems but also to actively contribute to sustainable solutions in a rapidly evolving world.

Reference:

RESEARCH CORRIDOR
Journal of Engineering Science

1. Anderberg, E., Nordén, B., & Hansson, B. (2009). Global learning for sustainable development in higher education: recent trends and a critique. *International Journal of Sustainability in Higher Education*, *10*(4), 368-378.
2. Gregersen-Hermans, J. (2021). Toward a curriculum for the future: Synthesizing education for sustainable development and internationalization of the curriculum. *Journal of studies in international education*, *25*(4), 461-481.
3. Makrakis, V., & Kostoulas-Makrakis, N. (2012). Course curricular design and development of the M. Sc. programme in the field of ICT in education for sustainable development. *Journal of Teacher Education for Sustainability*, *14*(2), 5-40.
4. Rukmana, A. Y., Mokodenseho, S., & Aziz, A. M. (2023). Environmental Education for Sustainable Development: A Bibliometric Review of Curriculum Design and Pedagogical Approaches. *The Eastasouth Journal of Learning and Educations*, *1*(02), 65-75.
5. Tella, A., & Adu, E. O. (2009). Information communication technology (ICT) and curriculum development: the challenges for education for sustainable development. *Indian Journal of Science and Technology*, *2*(3), 55-59.
6. Brunton, K. (2006). Education for sustainable development: principles for curriculum development in business subject areas. *Investigations in university teaching and learning*, *3*(2), 36-46.
7. Desha, C. (2013). *Higher education and sustainable development: A model for curriculum renewal*. Routledge.
8. Deroncele-Acosta, A., Jiménez-Chumacero, R. V., Gamarra-Mendoza, S., Brito-Garcías, J. G., Flores-Valdivieso, H. G., Velázquez-Tejeda, M. E., & Goñi-Cruz, F. F. (2023). Trends in Educational Research for Sustainable Development in Postgraduate Education Programs at a University in Peru. *Sustainability*, *15*(6), 5449.
9. Glavič, P. (2020). Identifying key issues of education for sustainable development. *Sustainability*, *12*(16), 6500.
10. Ryan, A. (2012). Education for sustainable development and holistic curriculum change: A review and guide.
11. Khadim, M., Tahira, S. S., & Naz, B. (2023). Emerging trends and research developments in education for sustainable development: Shaping conceptions for a sustainable future. *Annals of Human and Social Sciences*, *4*(2), 499-512.
12. Dambudzo, I. I. (2015). Curriculum Issues: Teaching and Learning for Sustainable Development in Developing Countries--Zimbabwe Case Study. *Journal of Education and Learning*, *4*(1), 11-24.
13. Franco, I., Saito, O., Vaughter, P., Whereat, J., Kanie, N., & Takemoto, K. (2019). Higher education for sustainable development: Actioning the global goals in policy, curriculum and practice. *Sustainability Science*, *14*(6), 1621-1642.
14. Cebrián, G., Junyent, M., & Mulà, I. (2021). Current practices and future pathways towards competencies in education for sustainable development. *Sustainability*, *13*(16), 8733.
15. Beynaghi, A., Trencher, G., Moztarzadeh, F., Mozafari, M., Maknoon, R., & Leal Filho, W. (2016). Future sustainability scenarios for universities: Moving beyond the United Nations Decade of Education for Sustainable Development. *Journal of Cleaner Production*, *112*, 3464-3478.
16. Wals, A. E., & Kieft, G. (2010). Education for sustainable development: Research overview.

17. Rao, P., Patil, Y., & Gupte, R. (2013). Education for sustainable development: trends in Indian business schools and universities in a post liberalization era. *Sustainability Assessment Tools in Higher Education Institutions: Mapping Trends and Good Practices Around the World*, 417-432.
18. Pavlova, M. (2013). Teaching and learning for sustainable development: ESD research in technology education. *International journal of technology and design education*, *23*, 733-748.
19. McKeown, R., Hopkins, C. A., Rizi, R., & Chrystalbridge, M. (2002). *Education for sustainable development toolkit* (p. 2002). Knoxville: Energy, Environment and Resources Center, University of Tennessee.
20. Læssøe, J., & Mochizuki, Y. (2015). Recent trends in national policy on education for sustainable development and climate change education. *Journal of Education for Sustainable Development*, *9*(1), 27-43.
21. Down, L. (2006). Addressing the challenges of mainstreaming education for sustainable development in higher education. *International Journal of Sustainability in Higher Education*, *7*(4), 390-399.
22. Sengupta, E., Blessinger, P., & Yamin, T. S. (2020). Introduction to integrating sustainability into curriculum. In *Integrating Sustainable Development into the Curriculum* (pp. 3-14). Emerald Publishing Limited.
23. Ferguson, T., Roofe, C., Cook, L. D., Bramwell-Lalor, S., & Gentles, C. H. (2022). Education for sustainable development (ESD) infusion into curricula: influences on students' understandings of sustainable development and ESD. *Brock Education Journal*, *31*(2), 63-84.
24. Jawahir, I. S., Rouch, K. E., Dillon, O. W., Holloway, L., Hall, A., & Knuf, J. (2007). Design for sustainability (DFS): new challenges in developing and implementing a curriculum for next generation design and manufacturing engineers. *International Journal of Engineering Education*, *23*(6), 1053.
25. Araneo, P. M. (2019). Future Trends in Sustainable Development. *Encyclopedia of Sustainability in Higher Education*, 695-713.
26. Fischer, D., King, J., Rieckmann, M., Barth, M., Büssing, A., Hemmer, I., & Lindau-Bank, D. (2022). Teacher education for sustainable development: A review of an emerging research field. *Journal of Teacher Education*, *73*(5), 509-524.
27. Zguir, M. F., Dubis, S., & Koç, M. (2021). Embedding Education for Sustainable Development (ESD) and SDGs values in curriculum: A comparative review on Qatar, Singapore and New Zealand. *Journal of Cleaner Production*, *319*, 128534.
28. Hallinger, P., & Nguyen, V. T. (2020). Mapping the landscape and structure of research on education for sustainable development: A bibliometric review. *Sustainability*, *12*(5), 1947.
29. Collier, E., Odell, K. E., & Rosenbloom, A. (2022). Teaching sustainable development: An approach to rapidly introducing the UN sustainable development goals into an undergraduate business curriculum. *Journal of Global Responsibility*, *13*(4), 361-379.
30. Missimer, M., & Connell, T. (2012). Pedagogical approaches and design aspects to enable leadership for sustainable development. *Sustainability: The Journal of Record*, *5*(3), 172-181.
31. Igwe, K. N., Musa, S. S., & Odenigbo, P. (2016). Addressing Contending Issues and Embracing Emerging Trends in Library and Information Science Education for Sustainable Development in Nigeria. *Covenant Journal of Library and Information Science*.
32. Buckler, C., & Creech, H. (2014). *Shaping the future we want: UN Decade of Education for Sustainable Development; final report*. Unesco.

RESEARCH CORRIDOR
Journal of Engineering Science

33. Lai, Y. C., & Peng, L. H. (2019). Effective teaching and activities of excellent teachers for the sustainable development of higher design education. *Sustainability*, *12*(1), 28.
34. Lansu, A., Boon, J., Sloep, P. B., & van Dam-Mieras, R. (2013). Changing professional demands in sustainable regional development: a curriculum design process to meet transboundary competence. *Journal of cleaner production*, *49*, 123-133.
35. Blewitt, E. B. J., & Cullingford, C. (2004). *Sustainability curriculum*. Earthscan.
36. Brudermann, T., Aschemann, R., Füllsack, M., & Posch, A. (2019). Education for sustainable development 4.0: Lessons learned from the University of Graz, Austria. *Sustainability*, *11*(8), 2347.
37. Brudermann, T., Aschemann, R., Füllsack, M., & Posch, A. (2019). Education for sustainable development 4.0: Lessons learned from the University of Graz, Austria. *Sustainability*, *11*(8), 2347.
38. Leal Filho, W., Manolas, E., & Pace, P. (2015). The future we want: Key issues on sustainable development in higher education after Rio and the UN decade of education for sustainable development. *International Journal of Sustainability in Higher Education*, *16*(1), 112-129.