

OKOYEAGU, C.J., OKPU, A., ESSIET, R. and ELDESSOUKY, H. 2025. Embedding sustainability in engineering education: empowering students with knowledge and skills for a sustainable future. Presented at the 9th International conference on research in education, teaching and learning 2025 (ICETL 2025), 21-23 February 2025, Milan, Italy.

Embedding sustainability in engineering education: empowering students with knowledge and skills for a sustainable future.

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2025

This output contains the published abstract, along with the presentation slides presented at the conference.

Embedding Sustainability in Engineering Education: Empowering Students with Knowledge and Skills for a Sustainable Future

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ABSTRACT

Integrating sustainability into engineering disciplines is essential for preparing students to tackle the complex environmental, social, and economic issues of the 21st century. This paper examines the significance of incorporating sustainability into engineering curricula, with the goal of equipping students with a thorough understanding of how their specialized knowledge can foster a sustainable future. By embedding sustainability principles in engineering education, students are inspired to critically consider the lasting effects of their work and to devise innovative solutions that align with the United Nations Sustainable Development Goals (SDGs). The paper outlines effective strategies for the integration of sustainability within engineering programs, emphasizing course design, teaching methods, and assessment practices that encourage interdisciplinary collaboration and real-world problem-solving. Through case studies and practical examples, it demonstrates how aligning engineering disciplines with sustainability objectives can nurture crucial skills such as systems thinking, ethical decision-making, and technical problem-solving. Additionally, it underscores the need to raise awareness of sustainability issues across engineering fields, empowering students to understand the interconnections among natural systems, technological advances, and societal needs.

In conclusion, the paper promotes a transformative approach to engineering education—one that enables students to leverage their expertise to create sustainable innovations, support environmental stewardship, and drive meaningful change. By equipping future engineering leaders with sustainability knowledge and competencies, we can ensure they are prepared to confront the pressing challenges of our global society and contribute to building a more sustainable future for generations to come.

Keywords: Engineering education, sustainability in engineering, interdisciplinary collaboration, Sustainable Development Goals (SDGs), curriculum design

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Introduction and Research Motivation



❖ Background

- Growing environmental, social, and economic challenges require a shift in engineering education.
- Sustainability is integral to global efforts in tackling climate change, resource depletion, and social inequity.

❖ Motivation

- Engineering plays a pivotal role in shaping sustainable solutions for the future.
- Current engineering education focuses predominantly on technical aspects, overlooking sustainability integration.

❖ Objective

- Investigate existing approaches to sustainability in engineering education.
- Examine barriers to effective integration of sustainability principles.
- Identify strategies to empower students with the knowledge and skills for sustainable engineering

The Role of Engineering Education in Sustainability



❖ Global Need for Sustainability in Engineering

United Nations SDGs emphasize the need for engineering solutions to address climate change, clean energy, sustainable cities, and responsible consumption.

❖ Existing Models in Education

Few engineering programs globally integrate sustainability comprehensively. Some focus on specific areas such as renewable energy, while others emphasize sustainable design.

❖ Gaps in Research

There is limited empirical research on effective pedagogical methods for embedding sustainability in diverse engineering disciplines.

Research Methodology



❖ **Approach:** Mixed-methods research, combining qualitative and quantitative data.

❖ **Data Collection:**

- Surveys of engineering students and departments to understand perceptions and practices related to sustainability..
- Interviews with industry partners to identify skills and knowledge needed by future engineers in sustainability.
- Assessing the real-world impact of student projects

Case Study: Sustainability in Action

❖ Program Overview

- The University of Melbourne's **Faculty of Engineering and Information Technology (FEIT)** has undergone a significant transformation to integrate sustainability into its engineering curriculum, with the goal of producing engineers who are not only technically proficient but also aware of their environmental impact and equipped to solve global sustainability challenges.

❖ Key Objectives

- Integrate Sustainability into Engineering Education
- Foster Systems Thinking and Interdisciplinary Learning
- Promote Innovation in Sustainable Technologies

❖ Methodology

- Curriculum Review and Revision
- Hands-On Learning and Real-World Applications
- Interdisciplinary and Cross-Departmental Learning

❖ Outcome

- High Employment and Industry Collaboration
- Significant Environmental and Social Impact
- Student Engagement in Sustainability Initiatives

Challenges and Barriers to Embedding Sustainability



Curricular Resistance

Academic staff members hesitant to change traditional course structures due to limited knowledge or perceived lack of resources.

Lack of Industry Integration

Insufficient partnerships between universities and industries focused on sustainable technologies.

Resource Constraints

Limited access to tools, technology, or funding to support sustainability initiatives within educational institutions.

Assessing Sustainability Knowledge

Difficulty in assessing and measuring student competency in sustainability across diverse engineering disciplines.

Strategies for Empowering Students with Sustainability Knowledge and Skills



❖ Enhancing Curriculum Design

- Integrating sustainability across engineering disciplines, not as a separate subject but as an integral part of every course.
- Encouraging the development of cross-disciplinary competencies, particularly in systems thinking and environmental stewardship.

❖ Promoting Student-Led Sustainability Initiatives

- Encourage students to design and lead projects that solve sustainability challenges within their community or the university setting.

❖ Industry Collaboration

- Building partnerships with sustainable businesses for internships, research opportunities, and guest lectures that provide real-world exposure.

Conclusion and Future Research



Embedding sustainability in engineering education is essential for preparing students to face the complex challenges of the future.



A comprehensive approach is necessary, incorporating curriculum redesign, hands-on learning, and strong industry engagement.



Investigate long-term outcomes of sustainability-integrated curricula on engineering practice.



Explore the role of sustainability in specialized engineering fields (e.g., aerospace, electrical, mechanical).



Examine how sustainability-focused engineering education influences career paths and industry practices.

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[Advancing Sustainable Development: Emerging Factors and Futures for the Engineering Field](#)



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"Sustainability is not a destination, but a journey we all must take, and as academics, we have a responsibility to ensure that the next generation of engineers are equipped with the knowledge, skills, and mindset to lead the way toward a more sustainable and equitable future."