Integrating Sustainability into Materials Courses through the Engineering for One Planet Framework

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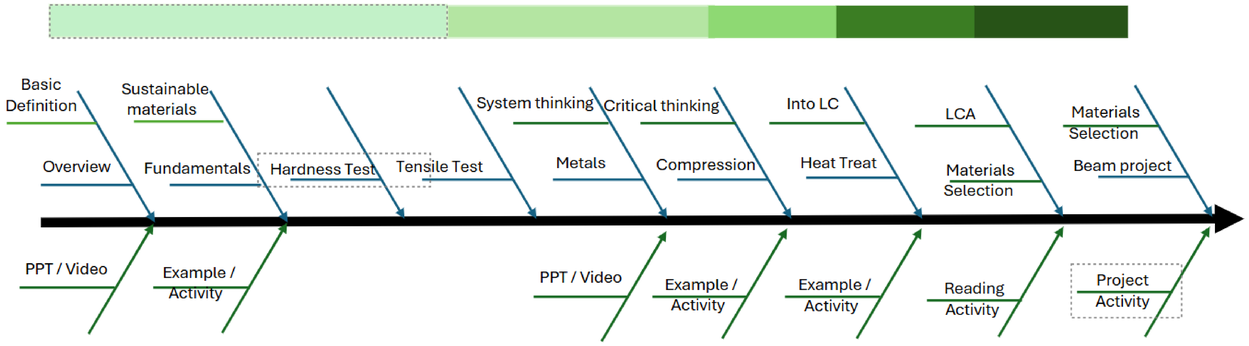
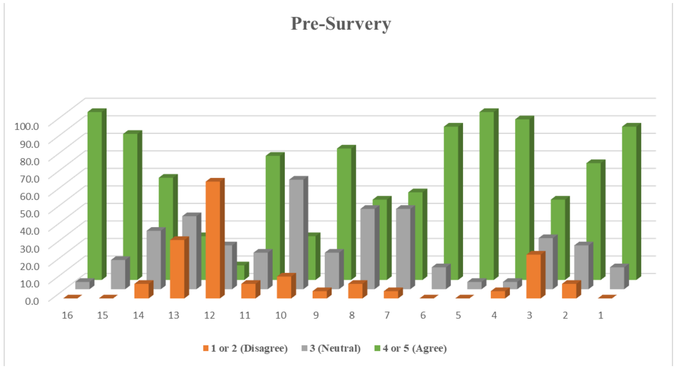
Introduction: Our team's curricular initiative centers on integrating sustainability principles into two core materials courses: Mechanical Properties of Materials and Construction Materials Technology. These courses are integral to the Engineering Technology and Construction Management programs at our mid-sized public Midwestern university and are typically taken by third-year undergraduate students. Historically, the curriculum focused on traditional mechanics and standardized material testing, with limited emphasis on sustainability. Recognizing the growing global need for sustainable engineering and construction practices, we redesigned these courses using the Engineering for One Planet (EOP) Framework, which emphasizes balancing environmental, social, and economic needs within Earth's limits.

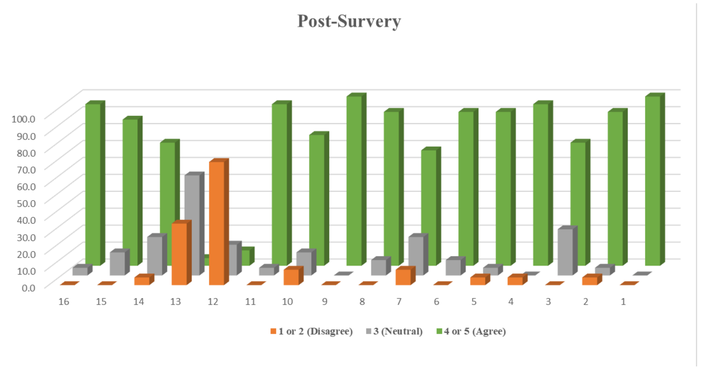
Progress and plan for scaling up: Initial results from piloting the redesigned curriculum show significant improvements in students' understanding of sustainability principles, with pre- and post-course surveys revealing increased knowledge, critical thinking, and engagement with sustainable practices. Hands-on activities and project-based learning have proven effective in fostering practical skills and a commitment to sustainability. Currently, we are refining the curriculum based on student feedback and aligning it with broader institutional goals. Moving forward, we plan to expand this approach to other courses within the Engineering Technology and Construction Management programs, collaborate with faculty across disciplines, and share our framework with peer institutions to promote widespread adoption.

Procedure: The project utilized the Engineering for One Planet (EOP) Framework to redesign the curriculum by mapping traditional materials topics to sustainability principles, incorporating hands-on activities such as lifecycle analysis (LCA) and testing sustainable materials, and integrating industry case studies. Pre- and post-course surveys measured knowledge gains, attitude shifts, and skill development across six EOP categories, including environmental and socio-economic impacts and sustainable technologies. Practical skills were assessed through lab activities and design projects, while follow-up surveys evaluated long-term impact. Tools such as universal testing machines, environmental chambers, and interactive LCA software supported implementation, with results showing significant improvements in student understanding and commitment to sustainability. The following figure illustrates the integration of sustainability principles into the curriculum through a structured timeline of topics and activities for the Mechanical Properties of Materials course .



Evaluation and Impact: The preliminary findings from pre- and post-course questionnaires demonstrate a significant positive impact of integrating sustainability principles into undergraduate student learning. Students showed increased knowledge and understanding of sustainability concepts, as well as enhanced awareness of the environmental, social, and economic dimensions of their professional work. These results highlight the effectiveness of the curriculum redesign in fostering a deeper commitment to sustainable practices and equipping students with the skills needed to address global sustainability challenges. The survey consisted of 16 questions categorized into six key areas: **General Understanding of Sustainability**, **Environmental Sustainability**, **Social and Economic Sustainability**, **Sustainable Technologies and Innovations**, **Personal Perspectives and Actions**, and **Assessing Knowledge and Attitudes**. The results of the survey are presented in the figures below, highlighting the progress made in each category and reinforcing the value of this structured approach to sustainability education.





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