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Engineering Education Approach to Develop Sustainability Competencies Using EOP Framework

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Abstract

The urgency of global environmental challenges has amplified the need to incorporate sustainability into engineering education. Future engineers must be equipped with the competencies to address complex sustainability issues yet aligning such content with existing ABET student outcomes can be difficult for many programs. This paper introduces an instructional model that integrates sustainability through project-based learning (PBL) within core engineering courses, guided by the Engineering for One Planet (EOP) framework. The approach is designed to address three core questions: (1) How can students become proficient in applying sustainability principles? (2) How can these principles support solving real-world, complex problems? (3) What sustainability competencies are essential for engineers in the future workforce?The semester-long model consists of seven structured modules integrated in 3000-level Engineering Economics course: Topic Understanding, Data and Information, Industry Context, Problem Definition, Solutions Benchmarking, Alternatives Analysis, and Optimal Solution Selection. Each module includes instructional materials, learning objectives mapped to course outcomes, case studies, and assessment tools. The model facilitates systems thinking by mapping learning activities to EOP framework areas: Knowledge and Understanding (e.g., responsible economy), Technical Skills (e.g., environmental impact design), and Leadership Skills (e.g., communication and teamwork). Initial implementation results demonstrate high levels of student engagement, improved recognition of sustainability challenges, and the development of innovative solutions. Students reported enhanced critical thinking and problem-solving skills and developed a strong sense of environmental responsibility. This approach offers a scalable model for embedding sustainability into engineering curricula without disrupting existing course objectives or accreditation alignment. Graduates of such programs will possess competitive sustainability competencies relevant to fields including renewable energy, sustainable design, and responsible business practices.

Keywords

Sustainability Education, Engineering Curriculum, Project-Based Learning, EOP Framework, ABET Outcomes, Systems Thinking