

Workshop: Using Open-Ended Design Projects to Foster Creativity, Entrepreneurial Mindset, and Motivation

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Mark's research interests revolve around developing engineers capable of leading and enacting positive change on their communities. His research explores the topics of entrepreneurial mindset, innovation, well-being, leadership, interpersonal skills, and other 21st century competencies. Mark has experiences in teaching and mentoring engineering students in human-centered design, social entrepreneurship, humanitarian engineering, leadership, and mindfulness.

How to Implement Open-Ended Design Projects to Foster Creativity, Entrepreneurial Mindset, and Motivation

By

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Objective

This workshop is designed for faculty who are interested in learning about how to implement open-ended projects (OEPs) in their engineering courses: in-person or online.

Open-ended projects, as presented in the workshop, are a great way to promote creativity, entrepreneurial-thinking, and motivation within freshman (or higher) engineering design courses. This workshop will provide strategies to plan and manage OEPs, especially those that include a physical-build component and require interdisciplinary skills. Presenters will share their experiences and results in running these projects for the past few years, in both online and in-person “Introduction to Engineering” courses.

Open-ended Projects - Significance

In an OEP, the central theme is that the teams of students define their own design challenge, usually within a focus area (e.g. automation, IoT, biomedical applications etc.). This choice is heavily linked to their motivation and creativity. Consequently, the students take a lead in navigating the design process, learning and applying engineering tools (e.g. 3D modeling, prototyping, Arduino) to develop a solution that creates value for their respective users. Many often go beyond the class expectations and take charge of their learning, in quite an inspirational way.

An important part of OEPs as we implement them is to make the project ‘real’ by requiring the students to design for specific customers or users whom they will interact with personally. The project is essentially run like a mini-capstone. Students practice entrepreneurial-thinking through customer interviews, pitch presentations, and design reviews to ensure they are actually addressing a need or problem and creating value for their potential customers.

Due to the open-ended nature of the projects, students must learn to deal with uncertainty and self-regulate their learning. Students continuously practice their communication, teamwork, and leadership skills throughout the project and must apply project management tools to plan ahead and delegate tasks amongst team members. Still, the project is scaffolded through various checkpoints and deliverables that are focused on keeping project teams on-track and providing substantive feedback. Students are held accountable and given feedback on their performance through periodic CATME peer evaluations and a flexible grading structure.

After experiencing an OEP, students are much more likely to participate in out-of-class engineering activities, e.g., engineering clubs, research projects, and even business ventures or start-ups.

Workshop Outline - What will the participants gain?

Here is the planned timeline of the workshop

Before coming to the workshop the participants fill out a short survey answering the following type of questions:

- What are your expectations from this workshop?
- What is your level of experience with project-based learning? (none to substantial)
- What types of projects have you used? To what extent would you consider the projects to be open-ended and why?
- What do you think are the benefits specific to OEPs?
- What challenges do you anticipate or have you faced in implementing OEPs?

During the workshop we'll start with a discussion on various dimensions along which the "openness" of OEPs can be defined or quantified (e.g. student autonomy in the project topic, complexity, openness in the solution space, level of imposed structure, etc.). Participants will be asked to place their past implementation of project-based learning along those dimensions. Using the pre-workshop survey results as a starting point, the participants and the presenters will discuss and create a concrete list of benefits and challenges associated with OEPs.

Then, we'll present the multi-phase approach we have used to run OEPs in our in-person and online courses for the past few years. The phases include skill development, team formation, project identification, etc. We'll specifically focus on addressing the challenges identified earlier. For each phase, attendees will be given the opportunity to share their own experiences, lessons, and strategies with design projects and specifically OEPs.

We will provide a variety of examples of students' projects from the past (including prototypes, videos, and demonstrations) themed around household and commercial automation. These projects will showcase how the customers were involved in the design process to make the projects more 'real' and entrepreneurial in spirit. They will clearly show how the students, motivated intrinsically, displayed creativity in choosing the problems to solve from their everyday lives.

At the end

Workshop participants will be encouraged to use the strategies shared to design or modify their own OEPs. Participants will be provided access to a toolkit that includes resources to support the implementation of an OEP. This toolkit includes:

- Example mini-projects and lectures/labs that cultivate necessary technical and non-technical skills needed before the students start the project (e.g. engineering design process, modeling, CAD, coding (Arduino), teamwork, and project management).
- Examples of course planning documents and assignment descriptions that can be modified or applied to effectively scaffold an OEP.

Our goal is that attendees will also leave with a strong understanding of how to successfully implement an OEP in their classes as well as resources to support the implementation of OEPs.

Depending on participant interests, there will be an opportunity to connect and discuss possible research collaborations that evaluate the efficacy of OEP and their impact on student learning including creativity, motivation, life-long learning, and interpersonal competencies.