Teaching Technological Innovation and Entrepreneurship in Engineering Electives

Newell R. Washburn
Carnegie Mellon University

Abstract

A model for incorporating an entrepreneurship project has been developed in a upper-division and graduate-level engineering electives at Carnegie Mellon University. A combination of lectures, assignments, and a team-based project were used to provide students with a framework for applying their technical skills in the development of new technologies and a basic understanding of the issues related to translational research and technology commercialization in the context of course material.

Focus Area: Project-Based Learning

Introduction and Objectives

The goal of team projects was to introduce students in engineering electives to technological innovation in the context of projects contained in engineering electives.

Four broad learning milestones were:

1. Identify opportunities for establishing intellectual property within a defined technology area

2. Search patent databases and read patents

3. Apply their technical skills to develop ideas for new technologies

4. Work in teams to refine ideas and propose a new technology

Developmental History of Innovation

The entrepreneurship project has been run in three semesters in Polymeric Biomaterials (BME/MSE). It originally took the place of a term paper that was found to be uninteresting by students and instructor alike.

Reference:

Teaching technological innovation and entrepreneurship in polymeric biomaterials. Washburn NR. J Biomed Mater Res - Pt A. 2011; 96:58-65.

Learning Activities and Materials

The entrepreneurship projects run concurrently with the traditional pedagogical components of the course. It is organized into the following project milestones:

1. Students submit ideas for areas to target as well as preliminary ideas for technologies.
2. Instructor forms teams based on students preferences from a compilation of anonymously listed topics.
3. Teams are asked to choose a team leader and team or product name.
4. Teams prepare a summary of target medical condition and examples of current therapies.
5. Survey of patent databases related to medical condition and identification of current products.
6. Teams propose preliminary technological solution based on their understanding of the medical condition and survey of the patent literature.
7. Teams present final material or device, including a schematic drawing and description of how it would function as well as submit a written report.

Example of a final project:

Execution

Some observations from running the entrepreneneurship project include:

- Reinforced content in traditional pedagogical course component
- Allowed connections between course content and real-world applications.
- In traditional course components, instructor got fewer questions related to “Why are we learning this?”
- Often the students who excelled in the project were not the top students in the traditional pedagogical areas of the course.
- Running this project is time-consuming.

Major Issues to Resolve

There are many main challenges in implementing the entrepreneurship project:

1. Students must learn basic course material related to their project and simultaneously apply it.
2. How much formal teaching related to innovation and entrepreneurship is beneficial for students?
3. Managing student teams is tricky – would individual projects be more efficient?
4. Does the project need to be more structured?
5. Running the project along with the rest of the course can be particularly time-consuming for the instructor.
6. Grading the projects rigorously is hard even with a rubric.
7. The project needs more real-world contact to assess market pull and challenges associated with implementation.
8. Students are often more interested in entrepreneurship than faculty, potentially making this less likely to become part of curriculum.

Discussion

CMU students in Polymeric Biomaterials have responded positively to the project. Next steps in the development include:

- Expand the project to other upper-division engineering electives.
- Develop better assessment tools to determine learning outcomes during the semester related to project and its effects on performance in the rest of the course.
- Perform prospective polling to assess whether the project alters post-baccalaureate activities such as pursuit of graduate degrees in engineering or business, patenting activities, overall professional trajectories, and aspects related to lifelong learning.
- Develop modules and other tools that make it easier for instructors to implement the project.
- Can it be integrated with Senior Design activities?
- Applying for NSF funding to improve, validate, and expand the project.

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