Fostering the Entrepreneurial Mindset in the Engineering Classroom

Aileen Huang-Saad, PhD
ailenh-s@umich.edu
Department of Biomedical Engineering, College of Engineering, University of Michigan

Introduction
- The global economy is evolving.
- Organizations are relying less on formal qualifications and years of experience and more on attitude, motivation, learning capacity, and potential for collaboration.[1]
- Mid-1990s ABET (Accreditation Board for Engineering and Technology) revision of engineering post secondary education.

In response to these changing market needs, the Biomedical Engineering Department piloted a two-semester graduate level course during the 2007-2008 academic year, Graduate Biomedical Engineering Design Team (BiomedE599).

Context
- The global economy is evolving.
- So how do we make it work?
- Students interested in joining the course for the winter semester were instructed to “apply” to the class and were evidenced by their performance outside of the classroom.
- Students are educated on commercialization aspects of development through a guest lecture series.
- Five project teams were formed by the end of the fall semester.

Final Deliverable
- Final design and prototype
- Patent Search
- Anticipated regulatory pathway
- Estimated manufacturing costs
- Market analysis

Learning Principles
Learning principles used were designed to:
1. Generate a culture that cultivates the highest probability of success for the students.
2. Encourage students to take ownership of their projects.
3. Provide students with the necessary skill sets for success beyond the University environment.

Fundamental Canons:
- Self-assembly promotes comfort amongst the team.
- Self-selection promotes buy-in and motivation.
- Self-awareness promotes more effective communication.

Team Experiences:
- Design Teams: Within the class, students divide into teams to pursue individual design projects.
- Class Team: Entire class instructed to work as a collective, similar to a technology incubator.
- Students develop concept designs as a collective.
- Students provide technical feedback to their peers on a weekly basis.

Course Purpose
- Develop adaptive learners through innovative design.
- Provide students with the necessary skill sets for success beyond the University environment.

Results
- Fall Semester: 18 students enrolled
- Winter Semester: 18 students enrolled (2 new, 16 return)
- Students interested in joining the course for the winter terms were instructed to “apply” to the class and were hired by individual team members.
- Five project teams were formed by the end of the fall semester.

Team
- Team Project Title (Clinical Mentor)
- Morphocor
- Minimally-Invasive Device to Prevent Heart Failure and Promote Healing (Stephen Bolling, MD)
- Moduline
- Stabilization of Perioperative Dwelllines to Reduce Infection Rates (Francis Papagi, MD, PhD)
- Neurosense
- A Quantitative Characterization of Parkinson’s Disease (Panag Patel, MD, PhD)
- Forbix
- Transdermal Drug Delivery System for Macromolecules (Charles Boyd, MD, MBA)
- Centaur
- A Novel Bolt Design for Arthroscopic Tibial Inlay Surgical Instruments (Jon Salkevy, MD)

Final Deliverable
- All teams guaranteed $500 for prototype development.
- Students not required to participate in any external competitions, but were informed of competition deadlines through the course website.
- Several teams opted to participate in various local and national competitions to generate additional funds during the fall and winter semesters.

At the conclusion of the class, several students pursued further prototype development and commercialization through external funds:

Fundamentals Canons
- Self Assembly
- Self Selection
- Self Awareness
- Design Teams
- Class Team

Discussion
- The culture cultivated during the two semester pilot course, resulted in more than a simple academic experimental exercise.
- Students embraced an entrepreneurial mindset as evidenced by their performance outside of the classroom.

Entrepreneurship is a particular type of mindset, a unique way of looking at the world. At the heart of entrepreneurship lies the desire to achieve, the passion to create, the yearning for freedom, the drive for independence, and the embodiment of entrepreneurial visions and dreams through tireless hard work, calculated risk-taking, continuous innovation, and undying perseverance.[2]

References

Acknowledgements

Fall Term
- Idea Incubation
- Self awareness promotes more effective communication.
- Self selection promotes buy-in and motivation.
- "I want to work on my own project, but I don’t have an idea."
- Students meet with UM medical community to discuss current clinical challenges.
- Students brainstorm with medical faculty about potential solutions to these clinical challenges.
- Students propose team design projects to be completed during the second semester.

Winter Term
- Idea Realization
- "So how do we make it work?"
- Students are educated on commercialization aspects of development through a guest lecture series.
- Speakers address commercialization topics including affordable design, ethics, intellectual property, product development, and regulatory consideration.
- Students build prototypes.

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Team Competition/Sponsor Award
- Myrrha
- NC3A BME Idea Stipend
- $500
- Moduline
- 2U Dare to Dream
- $500
- Neurosense
- NC3A BME Idea Stipend
- $500
- Forbix
- 2U Dare to Dream
- $500
- Medical
- U-M CoE CFE Sponsorship
- $3,000
- CFE CFE Quickpitch Competition
- $1,000
- Rose School of Business Future Tech Finalists
- $1,500
- Bay Area Innovators Trip
- $2,500

At the conclusion of the class, several students pursued further prototype development and commercialization through external funds:

CPLT
- Accolade
- Parag Patil, MD, PhD
- Jon Salkevy, MD
- David Harris, MD
- Parag Patel, MD, PhD
- Richard Raymond, PhD
- Steven Bolling, MD
- Charles Boyd, MD, MBA
- Frank Anderson, MD, MPH
- William Roberts, MD
- Frank Plogar, MD, PhD

References