Three Course Sequence in Medical Device Commercialization:
Part of a Master's in Biomedical Engineering Program

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Introduction

Biomedical engineering is an interdisciplinary field that involves the continuous development of new technologies that span the broad field of healthcare from managing patient information to aid decision making, to improving diagnostic equipment to detect disease and injury, to designing therapeutic solutions to treat disease and injury. At the University of Portland, for our new Master's in Biomedical Engineering, we developed a 3-course sequence. The aim is to provide a unique sequence that allows students to develop and market a medical device, exposing them to the real-world applications of biomedical engineering.

Materials and Methods

The Master's consists of 30 credit hours of coursework and a 6 to 10 week summer internship with a local medical device or applied research company in the biomedical field or at Oregon Health Sciences University (OHSU). Integrated into the program is a 3-course sequence to give the students the ability to turn their biomedical device innovative ideas into marketable products. One course is taken each semester: summer, fall, and spring, culminating in a team-based design capstone course where students present their entrepreneurial ideas to potential investors. Each of the three courses build upon each other to allow the students to work in teams to determine a design project, learn about all aspects of inventing, regulation, ethical issues, and commercialization, and then fabricate a prototype.

Results

For the Master's program, we have identified five student outcomes and will assess each of the outcomes using a minimum of two tools. Benchmark courses will include course-embedded assessment as a direct assessment tool. The program will also use annual internship surveys as an indirect assessment tool. These are summarized below.

1. Students practice real-world experiential learning (assessed with internship surveys from employers and students).
2. Students are skilled in the broad technical field of biomedical engineering including biomaterials, biomechanics, and bioinstrumentation (assessed in three required courses).
3. Students understand the business and patient care aspects of the healthcare industry (assessed in 3-course sequence, Fig.1).
4. Students can holistically analyze complex biomedical engineering issues, including ethical considerations (assessed in Biomedical Engineering & Society Capstone course and via a 5-year alumni survey).
5. Students demonstrate excellent communication skills across a variety of media (assessed in 3-course sequence, Fig.1).

Overall assessment of the program is critical since this is a very new effort for the Shiley School and for UP. Our overarching goals are to:
- Address the current interest among prospective students. We want to have at least ten UP students continue for their Master's in Biomedical Engineering at UP by the 2018 cohort. We have seven students this year.
- Be accessible for a broad range of undergraduate STEM majors. We want to have 20 percent of our enrollment come from non-engineering backgrounds, and we have achieved this.
- Our goal is to have 90 percent of our graduates placed in relevant employment within six months of graduation.
- Produce graduates who can immediately contribute to product development and technology innovation. We will evaluate this qualitatively through alumni surveys and news reports.
- Produce graduates who become recognized leaders in the industry and community. We will evaluate this qualitatively through alumni surveys and news reports.

Three-Course Product Development Process

Conceptual Innovation → Prototype & Concept Feedback → Iterate & Improve → Validate, Innovate, and IP Review → Business Model Canvas → Business Plan → Early Stage Venture

Fig. 1: The Three-course sequence development process.

Student projects will all be in the biomedical field and address social problems related to health. It is expected that some of the projects will improve medical technology while others will provide diagnostic tools for diseases. It is probable that some projects will also address environmental problems, such as water quality or preventing the spread of disease.

Conclusions

Biomedical engineering is an interdisciplinary field that involves the continuous development of new technologies that span the broad field of healthcare from managing patient information to aid decision making, to improving diagnostic equipment to detect disease and injury, to designing therapeutic solutions to treat disease and injury. Biomedical engineering is a field that directly impacts the quality of human life and by necessity, requires engineering professionals who are innovative, ethical, and sensitive to the business of healthcare delivery. In other words, it is a field where the University of Portland's guiding principles of "head, heart, and hands" are central to preparing leaders who can make a difference.

In our mission statement at the University of Portland, it states, "Because we value the development of the whole person, the University honors faith and reason as ways of knowing, promotes ethical reflection, and prepares people who respond to the needs of the world and its human family." Before approving the formation of a Master's in Biomedical Engineering, we had to detail how ethics would be taught in the program. We embedded this content in our 3-course sequence and specifically teach it in our Biomedical Engineering & Society Capstone course, as we feel this is critically important for all people but especially so for those in the healthcare field.

We feel the curriculum we've developed with the embedded 3-course sequence and experiential learning internship will produce graduates who can meet the diverse needs of the biomedical engineering profession.

Literature cited

http://engineering.up.edu/

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