2023 Annual Conference & Exposition
Baltimore Convention Center, MD | June 25 - 28, 2023
The Harbor of Engineering Education for 130 Years
ASEE
Paper ID #38361

Board 12: Work in progress: Assessment and impact of a Clinical Observations and Needs Finding service-learning course on Biomedical Engineering outcomes

Jacquelynn Ann Horsey
Dr. Mostafa Elsaadany, University of Arkansas

Dr. Mostafa Elsaadany is an Assistant Professor in the Department of Biomedical Engineering at the University of Arkansas. He received his Ph.D. in Biomedical Engineering from the University of Toledo. Dr. Elsaadany teaches Introduction to Biomedical Engineering, Biomechanical Engineering, Biomolecular Engineering, Senior Design, and Entrepreneurial Bioengineering. He is active in Engineering Education Research, where he studies different mentoring strategies to ensure the academic and professional success of underrepresented groups. Further, he studies strategies for instilling the entrepreneurial mindset in engineering students as well as innovative approaches to teaching such as using virtual reality.

Dr. Timothy J. Muldoon, University of Arkansas

Dr. Timothy Muldoon is an Associate Professor in the Department of Biomedical Engineering at the University of Arkansas. Dr. Muldoon teaches the Clinical Observations and Needs Finding, the Biomedical Instrumentation, and the Biomedical Microscopy courses within the Department, and also serves as the Undergraduate Coordinator. Dr. Muldoon's research interests include engineering education, miniaturized optical imaging and spectroscopy approaches for endoscopy applications, and metabolic imaging of the tumor microenvironment.

Work in progress: Assessment and Impact of a Clinical Observations and Needs Finding Service-learning Course on Biomedical Engineering Outcomes

Ms. Jacquelynn Ann Horsey, University of Arkansas

Jacquelynn is an undergraduate student in the Department of Biomedical Engineering.

Dr. Mostafa Elsaadany, University of Arkansas

Dr. Mostafa Elsaadany is a Teaching Assistant Professor in the Department of Biomedical Engineering at the University of Arkansas. Dr. Elsaadany teaches Introduction to Biomedical Engineering, Biomechanical Engineering, Biomolecular Engineering, Senior Design, and Entrepreneurial Bioengineering. He is active in Engineering Education Research where he studies different mentoring strategies to ensure the academic and professional success of historically marginalized minorities. Further, he studies strategies for instilling the entrepreneurial mindset in engineering students as well as innovative approaches to teaching such as using virtual reality.

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* Corresponding author: tmuldoon@uark.edu

Abstract:

In the field of biomedical engineering, clinical observation courses provide an opportunity for students to learn about engineering design and engage with clinicians via completing rotations in medical facilities near our campus. However, given the broad range of institutional resources available- such as proximity to a medical school, or residency programs- reporting the efficacy of such courses within the context of such available resources is of broad interest to the engineering community. This study sought to measure the effectiveness of a clinical observations course designed for a major land-grant, public university without proximity to a medical school. We compared IP generation and pre- and post-class surveys were used to quantify students' self-efficacy, motivations, and ability to make connections to real-world problems. The total number of IP applications increased more than two-fold following the adoption of the course, and survey results indicated students' collective improving understanding of the design process. Ongoing work will continue to examine the long-term impacts of the course with respect to the above metrics as well as student retention and graduate placement.

Introduction:

Myriad undergraduate Biomedical Engineering programs have developed programs that seek to provide an element of "clinical immersion" for students to learn about real-world problems which can be solved by engineering design [1-5]. However, given the diversity of such programs across the country concerning resources available, such as proximity to a major medical school, teaching hospital, active residency programs, etc., it is challenging to derive a universal "one size fits all" approach for such a course, as well as challenges in reporting their efficacy [6–8]. The objective of this WIP paper is to examine the efficacy of the clinical observations course as developed for our specific regional constraints. We are a land grant state University, the only Ph.D. granting program in Biomedical Engineering in the state but are more than three hours from the nearest research-intensive medical school and teaching hospitals, which presents logistical and collaborative challenges. The rural nature of our state leads to unique healthcare considerations and disparities that present unique opportunities for our students to learn. Students are placed in a variety of nearby medical clinics, private hospitals, and some University-affiliated allied health sites. The course is officially designated as service-learning due to the strong involvement with the local community and the aim to close the gap in local healthcare disparities; projects developed by students are intended to ultimately aid local clinician partners. This course fits logically into the undergraduate biomedical engineering curriculum, but the specific effects of the course and its specific implementation have yet to be quantified.

Methods:

To quantify differences in IP creation, the office of Technology Ventures provided data on the number of invention disclosures, patent applications, and patents awarded. Long term, IP generation can be better quantified via actual awarded patents and this will be tracked in future

work. We ran a query against all the Biomedical Engineering undergraduate students from 2013 to 2022 to obtain these numbers. The perceptions and opinions of students were measured through a Qualtrics survey that was administered during the first week of the course and again during the last week of the course. The survey contained Likert scale questions in addition to open-response questions. The questions evaluated students' interest in the development of medical devices in addition to their understanding of the FDA approval process. The Institutional Review Board (IRB) approved the current study (IRB protocol #: 2209420237).

Results:

The total number of IP applications from 2012 to 2018 (the first year the Clinical Needs course was offered) was 19. From 2018 to 2022, this number increased to 44. This increase may be attributed to the introduction of IP topics in the class as well as the accelerated product development cycle in senior design.

The results of the course survey were quantified using the Likert scale. Overall, there is a high level of enthusiasm for the Clinical Needs and Observations course itself, with students specifically identifying excitement for the opportunities to speak with clinical professionals and gain an understanding of the role engineers can play in clinical settings. The results of Question 1 are displayed in Figure 1 (A). This question primarily served to quantify students' confidence as related to medical device design and real-world implementation. Before completion of the course, only 9.1% of students strongly agreed with the statement. During the second administration of the survey, 22.7% of students strongly agreed. Question 2, seen in Figure 1 (B), aimed to determine how confident students were at identifying a test to improve a product. Following completion of the course, 100% of students agreed or strongly agreed with the statement, a noticeable increase from the initial data.

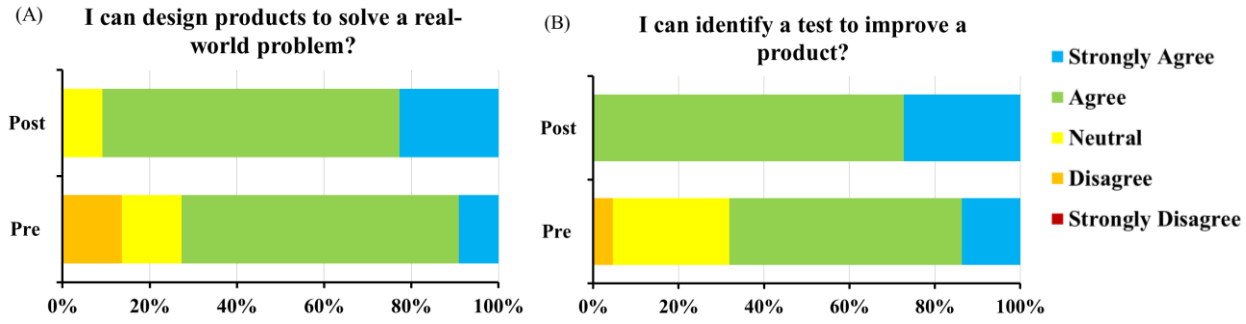

Figure 1: The results of Question 1 (A) and Question 2 (B) as reported before and after completion of the course.

Question 3, visible in Figure 2 (A), asked how confident students were with understanding the motivations and concerns of customers. Prior to the course only 31.8% strongly agreed with the question. During the post-course survey, 45.5% of students reported strongly agreeing. This positive shift indicates that the course improved students' understanding of customers' motivation, an important topic within the design process. Question 4, seen in Figure 2 (B),

focused less on the content covered in the course, and more on the method by which the course was completed- specifically teamwork. Initially, 50% of the class reported strongly agreeing with the statement. During the post-course survey, this value climbed to 68.2%. This is a positive outcome, as the ability to work in a team is not only necessary for coursework but is a valuable trait to carry into future careers.

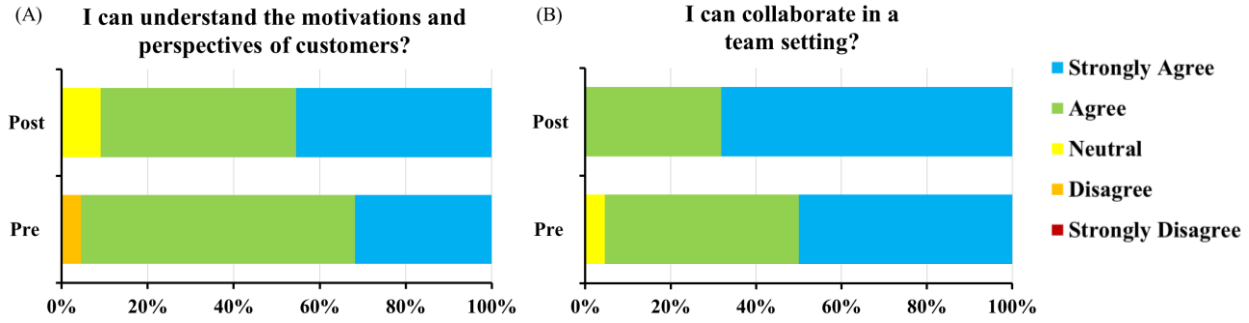

Figure 2: The results of Question 3 (A) and Question 4 (B) as reported before and after completion of the course.

Question 5, seen in Figure 3 (A), asked students how confident they were in their abilities to provide relevant solutions as an engineer. Before the course, not a single student reported strongly agreeing with the statement: 54.5% agreed, 36.4% were neutral, and 9.1% disagreed. During the post-course survey, the data shifted in favor of agreement: 50% of the class strongly agreed, 45.5% agreed, and 4.5% remained neutral. Figure 3 (B) displays the results of Question 6, which simply gauged the interests of students. These results suggest that the course was successful in building confidence in students as engineers and fostering interest in device design.

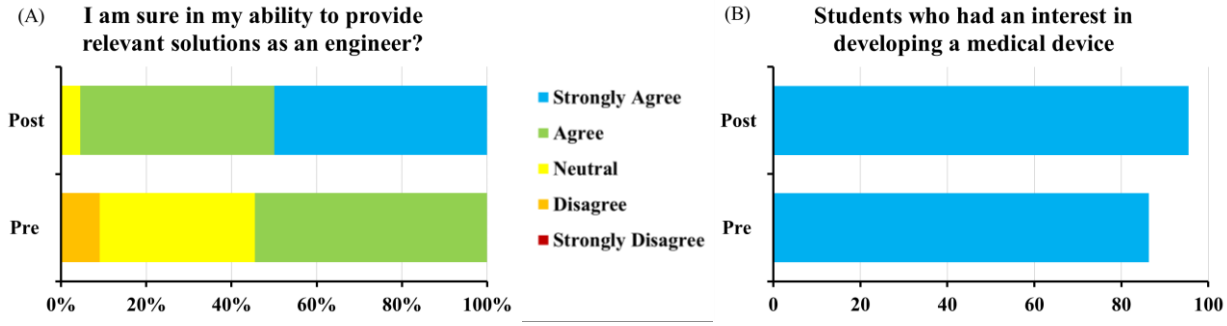

Figure 3: The results of Question 5 (A) as reported before and after completion of the course. The results of Questions 6 (B) as reported before and after the course.

These preliminary results indicate that the introduction of the clinical observations and needs course had a positive impact on our undergraduate Biomedical Engineering students. Our team is conducting a continuing, longitudinal study to track the short-term (survey data, and IP applications) and long-term (via exit survey and job placement data, awarded patents) performance of this clinical observations course.

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