Board 3: Work in Progress: Design Sprints as a Method to Explore the Biomedical Engineering Discipline

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abstract

This Work in Progress describes the implementation of an alternative framework to explore emphasis areas in an Introductory Biomedical Engineering course. In many Universities with an engineering department, part of the student experience is to show students the possibilities with an engineering degree. These possibilities are generally explored through presentations by faculty, lab and class experiences, or having the student research their interests and report their findings. An Introduction to Biomedical Engineering course was developed to allow students to explore the potential areas of interest relating engineering, biology, genetics, and medicine. In previous iterations of the course, emphasis areas were explored through student's researching published documentation and then presenting the information in a written and oral format. This paper describes how design sprints were introduced to the students and implemented into the introduction course to have students explore biomedical engineering and to conceive solutions to problems that they found within each emphasis area of biomedical engineering. The students would present their findings in written and oral format. The transition to a sprint framework was well received from the students and a good alternative to exploring subsets of the biomedical engineering discipline.

introduction

Engineering programs in many universities require students to experience an introductory class that will showcase features and niches within their offered disciplines (Chemical, Electrical, Mechanical, Biomedical, etc.) The goal, introduce a student to the potential opportunities within engineering, which the student can use to focus their education while obtaining their degree. At the University of Southern Indiana (USI), the Bachelors of Science degrees are in: Engineering (BSE), Mechanical Engineering (BSME), Electrical Engineering (BSEE), and Civil Engineering (BSCE). The students participate in an introductory course, however, as a result of the available degrees, biomedical engineering (BME) is only discussed briefly throughout their education.

To inform students of the possibilities in BME, an Introduction to Biomedical Engineering Course was developed. Introducing the emphasis areas within BME is conducted by using the Introduction to Biomedical Engineering by Enderle and Bronzino [1] as a guide. The text divides emphasis areas of BME (Biomechanics, Biomaterials, Bioelectricity) into chapters and takes students through these areas and supplies examples. In the courses first iteration, students used the book as a starting point and then explored research topics of interest and then presented the research, how they would use the research, and how they would improve upon the research. Examples by students include neural electrodes in bioelectricity and the mechanics of hitting a golf ball in biomechanics. The course used this method to explore emphasis areas, but other programs also use case studies, or lab activities [2, 3, 4]. In its first implementation, the method of exploring research topics of interest was beneficial, but many times the research topic was above the understanding of the undergraduate student. An alternative to explore emphasis areas in BME was needed, and a focus towards available technologies within BME was of interest. Further, with only a single semester to explore and share emphasis areas, usage of agile thinking processes, could streamline the introduction of emphasis areas within BME.

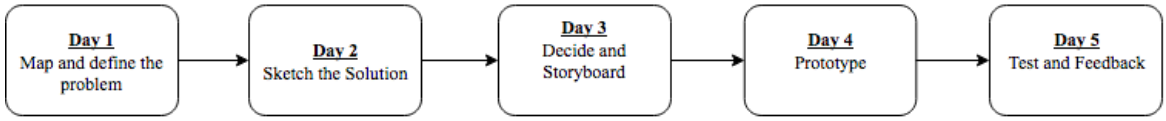

Figure 1: Five Day Google Sprint Process

Agile thinking processes (SIMPLEX, Google Sprint, and SCRUM) have emerged recently as methods to quickly determine the validity of a process or solution to a problem in a minimal time frame [5, 6, 7, 8, 9]. At the end of these processes, a business or group can then decide whether to continue developing the idea. This has implications of savings by getting user and customer feedback without investing a large amount of time or money. This university has been using the Google Sprint [5] process (Figure 1) within a multidisciplinary summer program aimed at entrepreneurial and commercial viability. While observing and mentoring the program, the sprint process could fit well within the exploration of BME. As the sprint process is designed to be completed in a week putting in approximately 40 plus hours a week, select portions of the sprint process are used to explore the emphasis areas within the time constraints of the class and semester. This paper discusses how parts of the sprint process is used as a tool to help students explore areas of biomedical engineering.

course and exploration structure

The Introduction to Biomedical Engineering course is a 3 Credit Hour elective broken down into bi-weekly meetings of 115 minute. The students (10 registered) were taken through several areas in BME (Figure 2). Then the students conduct exploration (using sprint components) of biomechanics, biomaterials, bioelectric, and bioinstrumentation phases. The main steps within the Google Sprint include:

- "Lightning Demos" - 3 minute presentation of important findings after research/inspiration
- " 4 Step Sketch" - Collecting ideas from research and lightning demos, creating initial sketches, performing crazy 8's, and creating an individual final solution sketch
- Group Decision - Determining as a group their best collective idea.

The five-day breakdown (Figure 3) of activities introduce the students to an emphasis area, determine a problem they are personally interested in, explore what has been done to combat the problem, determine individual solutions, decide on a group solution and present their exploration to the other students in the class. Assessment of student work is conducted through homework assignments and a report and presentation within each area. Assessment of the introduction course and the sprint process was done through written feedback provided to the instructor after final grades were submitted.

discussion

Upon adapting the course areas using the sprint process (Figure 1), time is the main limitation within the classroom. At the beginning of the semester the complete sprint process is discussed however, it was realized that completing the entire process would only allow for exploration of one emphasis area thereby limiting the breadth of BME. The lighting demos and 4-step sketch allowed the students to quickly converge on their ideas

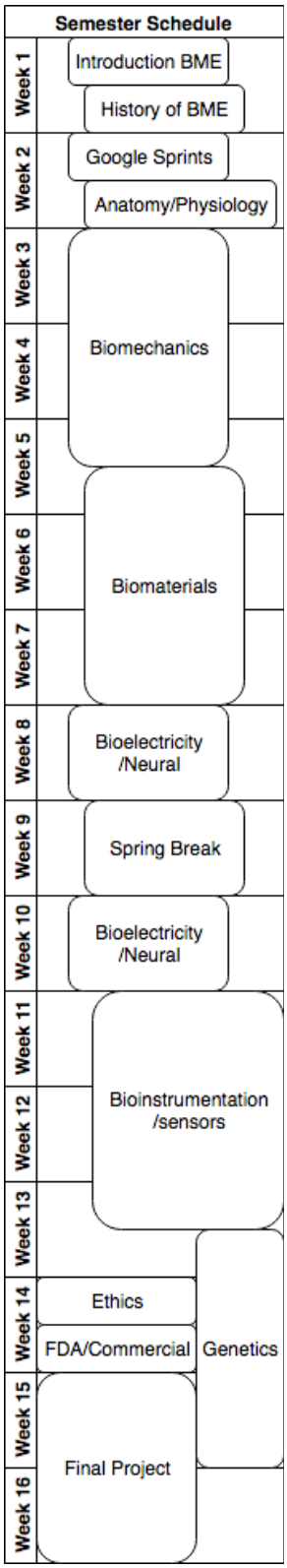

Figure 2: Semester Schedule

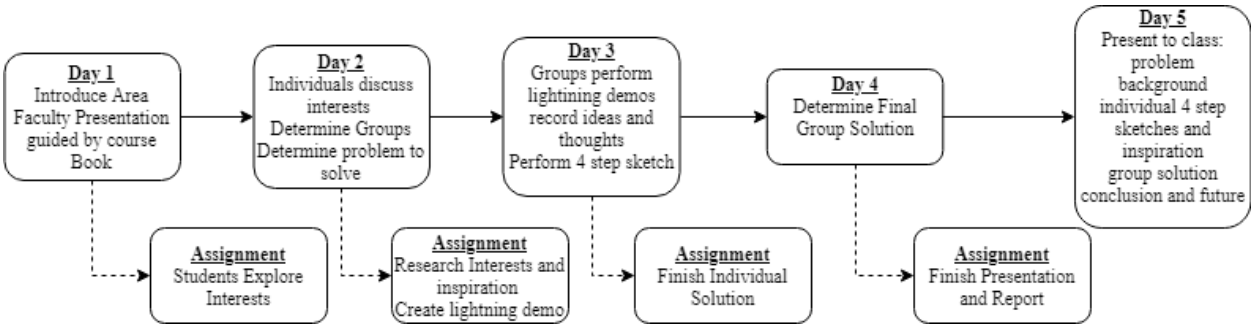

Figure 3: Breakdown of Activities in Emphasis Area

"liked the modular format of the course" and "it introduced different forms of thinking", but a second comment focused on the difficulty of the process. The comment related to not following the sketch process to determine a solution. The converging on a final solution isn't completed until later in the process (Figure 3 – Day 4). Outside of the two comments recorded in the student evaluations of teaching, there was verbal recognition of the process during the course. Again, the first time through, the students would question the process and try to understand the point, but as later iterations occurred, they would see the sprint's benefit. Student exploration did merit several areas of interest including exploring topics in exoskeleton suits, the heart, rheumatoid arthritis, blood vessel biomatrices, the large intestine, alcohol and memories, temporal lobe epilepsy, congenital insensitivity to pain, and artificial intelligence. With these explored areas, the student groups presented their findings to the remainder of the class allowing all students to observe the potential area to use their engineering degree. As the semester progressed, the process became streamlined with the course times. In the future, this will allow more areas to be explored, and allow students to observe more emphasis areas within the biomedical engineering discipline.

At this stage, oral and written feedback from student regarding the sprint process to explore BME was the focus. Based on this feedback a more formal assessment of how the course impacts the student's interest is needed. The main goal of the course is to help students realize the potential areas that their engineering degrees could be used. To work towards the impact of the course and obtain statistical assessment, a survey will be developed following based on an intrinsic Motivation Inventory (IMI). Questions will be created that ask the students to reflect on how each emphasis area has impacted their interest on the topics discussed. Questions pertaining to whether they knew the emphasis area existed, their interest in emphasis area, and if they now want to pursue the field of interest will be developed.

conclusion

Beneficial parts of the sprint process were implemented successfully into an introductory biomedical engineering course. The usage of the methodology allowed students to explore areas of biomedical engineering, and to express their interest and what they would like to do within the discussed fields. Overall, from student comments there were no responses from students regarding that the process was not useful and enjoyed learning a new form of thinking. The course can be further refined to involve more areas of biomedical engineering and allow the students to explore more possibilities within the biomedical engineering discipline. Lastly, experimental means will be developed to scientifically determine if the student's interest are changed due to the introduction of the biomedical discipline.

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