Using Project-Based, Experiential, and Service Learning in a Freshman Writing Intensive Seminar for Building Design and Technical Writing Skills (Work in Progress)

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Dr. Bilal Ghosn is a lecture in the Department of Bioengineering at Rice University. A native of Louisiana, he received his doctoral degree in Biomedical Engineering from the University of Texas at Austin in 2009 with his doctoral research in the areas of drug delivery, biomaterials and diagnostics. He then spent 4 years as a post-doctoral fellow in the department of Bioengineering at the University of Washington where he further developed his skills in polymer science, biomaterials, gene therapy, and cancer therapeutics. Dr. Ghosn then moved into a post-doctoral position in undergraduate education at Rice University in 2013 and was later promoted to a full-time lecturer position in Fall of 2014 teaching a variety of courses including labs in Bioprocessing and Tissue Culture along with a lecture course in Molecular Techniques in Bioengineering.

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Extended Abstract

Writing and design are two key skills that engineering students should develop to achieve success. Most commonly, students are exposed to training for these skills separately in the early years of their collegiate coursework followed by their combination in the latter years of study, particularly in upper-level design courses. In fall of 2014, we introduced "Design for Disabilities: Engineering Design Principles for Minimizing Patient Limitations," a new first-year writing intensive seminar (FWIS), in an attempt to expose students to engineering design principles and technical communication in the context of an experiential-learning project early in their college careers. By doing this, we hoped to provide a strong foundation for the development of core competencies in our engineering students.

Background

In 2012, Rice University launched a First-year Writing Intensive Seminar (FWIS) Program. In contrast to traditional composition courses, which often emphasize expository writing, FWIS courses focus on a field of study and offer students greater exposure to topics related to their interests. Written and oral communications play a significant role in the course syllabus, assignments, and course grade. To support the faculty's efforts to provide feedback on assignments and to facilitate more personal interaction, FWIS courses are capped at 15 students.

In Fall 2014, "Design for Disabilities: Engineering Design Principles for Minimizing Patient Limitations" was developed to provide students with exposure to design principles, the design process, and technical writing and to apply this new knowledge to the real-world challenge of designing for patients with disabilities.

Course Breakdown

Course Materials and Topics

This course focused on three objectives which are (a) to introduce design principles and their application, (b) to develop technical writing skills, and (c) to gain experience through service with local partners. More specifically, teams of students were tasked with designing creative, effective, low-cost supportive equipment for children with disabilities.

The core material for this course focused on lectures and class discussions that revolved around design principles in engineering and technical writing. The writing topics for the course included targeting an audience, language and terminology for technical documents, preparing effective figures and tables, interview development and structuring technical genres (e.g., reports,

proposals, and memos). Furthermore, students were lectured on design topics ranging from needs identification, development of design goals and criteria, use of Pugh and decision matrices, and the iterative process. Several lectures also addressed the complex usability and ethical issues associated with designing devices for patients with disabilities.

In an effort to provide students with hands-on experiences within the design process, multiple activities were incorporated into the course, which included students spending a day in a wheelchair, participating in a marshmallow spaghetti challenge and working on the design and prototyping of a spoon for children with Arthrogryposis, a disorder that limits a patient's range of motion in joints such as the wrists and elbows. Classes were rotated between the lectures and class time spent in the design lab implementing group design projects. Students were also asked to use the information garnered from their patient interviews to identify patient needs and potential possibilities for future design projects and to advocate for those projects in proposals submitted at the end of the course.

Assignments

To evaluate students, a variety of written assignments were assessed. These included:

- Needs assessment of a student or staff member with a physical disability
- Experiential essay on the student experience of spending a day confined to a wheelchair
- Ethical assessment of cochlear implants for deaf children
- Critical analysis of a current wheel chair technology
- Design report for their spoon prototype
- Proposal for a future project based on their interviews with patients at our partner hospital.

These proposals were used to evaluate potential projects in our following semester's first-year, one-semester freshman design course. These writing assessments focused on the students' abilities to effectively communicate in a clear and concise manner. Revision and iteration were emphasized in the writing process and the design process.

Student projects also provided students with early exposure to team work and collaborative writing. Groups of 3 to 4 students worked on the Arthrogryposis spoon projects in an effort to promote team dynamics and to aid in the rapid production of low-fidelity prototypes. Groups of 2 to 3 wrote the team proposals for the problems identified in the student interviews. While each aspect of this course on its own was not novel, we feel the incorporation of all of these activities into a freshmen writing course is a new approach for introducing students to engineering and its principles.

Assessment of Course

Overall, the goal of this course was to expose incoming freshmen students to the principles of engineering design and technical writing, while also increasing their interest and enthusiasm for engineering. This was a relatively small course with only 7 students, providing a lot of direct instructor interaction with the students. Both student groups for the arthrogryposis projects produced successful low-fidelity prototypes as shown in **figure 1** below. Student performance on the written and oral communication assignments resulted in a class average of 90.9% ± 3.76%, and demonstrated effective student performance.

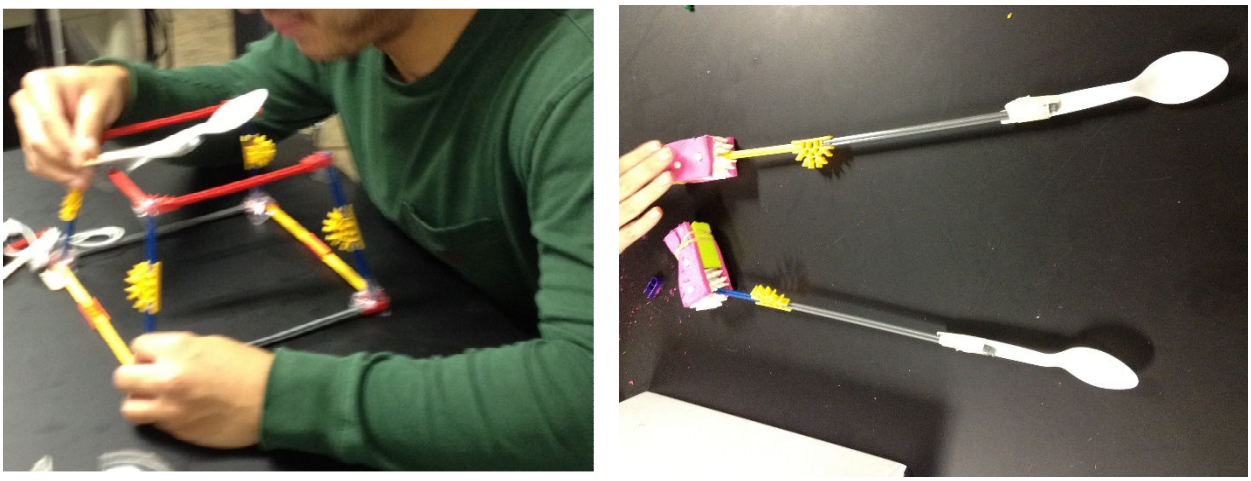

Figure 1. Low fidelity prototypes for spoons to aid young arthrogryposis patients.

After the course concluded, students were asked to respond to statements in a course evaluation survey using a 5 point Likert-scale with 1 being strongly disagree and 5 being strongly agree. Overall, students' attitudes towards the course were positive and encouraging with an average rating of 4.6/5.0 (5 responses) when asked how they would rate the quality of the course. All students indicated they would recommend the course to a friend (4.8/5.0, 5 responses). Similarly, students generally felt that the course provided an effective introduction to the engineering design process (4.2/5.0, 5 responses), and they identified the wheel chair day experience and design project (prototyping) as effective activities for learning design principles with each getting 2 votes out of 5 respondents for best activity. Finally, students felt that the incorporation of design elements enhanced the writing lessons in the course (3.8/5.0, 5 responses). While this first iteration of the course was structured to allow for some real-time student direction of how it would evolve, the overall response has been positive. However, continued refinement of the course is planned.

Conclusion

While the understanding and application of design principles in the course were key components, this course provided students an introduction into the world of engineering, technical writing and interacting with a client/patient. Based on both student performance and feedback, we feel this

course has met its goals with students given the opportunity to develop a prototype, work with patients, and develop technical communication skills. While this was an initial run for this course, we hope to continue our evaluation of the course in the coming cycle.