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Work in progress: Using clinical advisory boards and an online system to provide feedback for client-based senior design projects

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Abstract

In our capstone design class, biomedical engineering (BME) students develop custom assistive technology for people with disabilities in the local community. Project ideas come from therapists and clinicians in Durham and Chapel Hill. Students spend the entire semester working on the design and development of a device that meets the client's need. This work involves a significant clinical understanding to ensure that the final device will be appropriate for the client. To provide this clinical perspective, each project was assigned to a separate clinical advisory board, consisting of at least two clinicians; one or two current graduate students in Physical Therapy or Occupational Therapy; an individual with a disability from the community; and two alumni from the class. The advisory board provided feedback to the students throughout the semester. As a result, students received helpful feedback that they could incorporate into subsequent designs, which ultimately improved the success of their project. Future changes will further strengthen the interaction between the advisory boards and the BME students.

Introduction

We teach a capstone design class collaboratively at University of North Carolina and Duke University, in which biomedical engineering (BME) students develop custom technology for individuals with disabilities in the local community.[1] This is one choice among several design classes offered at each university. Between the two universities, we typically have a total of 10 projects in the class and teams of 2-4 students. Throughout the semester, each student group works closely with the person with a disability (the client), as well as the client's family and their local health care providers to develop a custom device that meets the their needs. At the end of the semester, the clients receive the completed devices free of charge.

To be successful, the devices must be safe, functional, durable, and correctly address the clients' identified needs. Since they will be using these devices as part of their daily lives, the devices must meet a higher standard than a typical capstone design project, where for example, the final product might be a prototype or even a paper design. While our BME students have education in engineering, they have neither the training nor the experience to address the clinical issues such as disease, disability, and function.[2] This is why clinical feedback is so important.

To address this issue, each project has a primary clinical advisor, typically an allied health or special education professional who works with the client. Throughout the semester, students have regular, ongoing interactions with the client and clinical advisor, where they can ask questions and receive feedback on their ideas from a clinical perspective. These interactions involve in-person meetings as well as communication by phone and email. BME senior design programs at other institutions often utilize clinical advisors in a similar fashion to augment the role of course faculty.[3-4]

However, because of the high standard that these projects must meet, we want the students to receive additional feedback from experts with a clinical background *who are not tied closely to*

the client. Our experience is that these individuals can provide an independent perspective on the students design ideas, leading to improvements in final project.

In previous years, we invited clinicians from the local community to attend the students' oral presentations throughout the semester and provide clinical feedback on the projects. However, few clinicians were able to come to campus and attend these presentations due to busy clinical schedules. Subsequently, in an effort to make it easier for these outside clinicians to provide input, we created an online blog that contained the written progress reports of each student group. We asked local clinicians to provide feedback through this online mechanism. Even though they could do this outside of their busy work schedules, it was overwhelming for the clinicians to look at updates from 10 different projects and decide which, if any, they would focus on. As a result, the students received virtually no feedback from outside experts through this mechanism.

We have addressed this issue by creating an advisory board for each project to provide students with independent feedback on their designs. These advisory boards supplement the ongoing feedback that students already receive from faculty and their clinical advisors. The goal was to make it as easy as possible for these outside experts to review the students design ideas and provide them with comments. We accomplished this by having each individual serve on an advisory board for only one or two projects, so that they could focus their efforts and minimize their time commitment. In addition, while board members could interact directly with the students when feasible, they could also use an online system to interact with the students remotely, again making it easier for the board members to contribute without taking time out of their busy work schedules.

Procedures

Each clinical advisory board consists of: at least two clinicians (one who works with the client and one who does not); one or two current graduate students in Physical Therapy (PT) or Occupational Therapy (OT); an individual with a disability from the community; and two alumni from the class. Each of these individuals can provide valuable feedback to the students from their position of expertise, whether it is clinical, personal, or having already experienced this class.

When possible, the BME students met with members of their advisory board directly to solicit feedback. However, this can be challenging because these advisory board members are busy, as well as physically scattered across the community or even more distant. Therefore, we also had students prepare materials electronically and post this on an online Wordpress blog.

For example, each student group prepared a mid-semester update just before spring break. This consisted of a narrated PowerPoint presentation, in which the student records audio for each slide. Each presentation also included video footage of the client testing their prototype device. The students saved these presentations as a single 5-8 minute long video and posted it to the Wordpress blog. We asked the advisory board members to watch their group's presentation and provide feedback using the built-in comments feature of Wordpress. In addition, we sent the link to the Wordpress blog to a broader audience, including engineering faculty at our universities,

former clients and advisors, and other clinicians, so that others who were interested could provide feedback to our students. Therefore, while the students were away on spring break, normally a time when they are making no progress on their projects, they were getting feedback from outside experts.

Involvement of OT and PT students

Several advisory board members were graduate students in PT or OT at the University of North Carolina. We worked with the faculty to identify students who were at an appropriate stage of their education and interested in interacting with the clients and with our students. They participated as an independent study project that was supervised by a faculty member, or on their own time.

Results

For their mid-semester online presentation, students received an average of 12 outside comments. Most of these were from advisory board members, but some were from other individuals who received our general request to provide feedback. We asked the students to respond to these comments, and this often led to ongoing interactions.

Below is a sampling of the feedback that one group received. This was for the development of a custom laptray and pencil/cup holder for a girl who uses a wheelchair. The laptray needed to be stowed away when not in use, using a mechanism that the girl could operate independently. On the Wordpress blog, the names used are pseudonyms to keep the client's identity confidential.

> Nice work! Is there a mechanism in your design that prevents the tray from sliding in or pushing into Emma's stomach during travel? Some trays have a locking mechanism to ensure safety especially if the tray is to be used while moving.
>
> Very clever design! It looks like you have been thorough with your considerations. A few questions: 1) How well is Emma able to propel her wheelchair with the tray in its down position as well as its functional position compared to her ability before the tray was added? 2) Would Emma be able to reach behind her to put her leg braces on the back hooks, or is this something somebody else would have to do for her? 3) Did Emma give any feedback on the tray? During our initial meeting, she seemed concerned with the potential aesthetics of the tray. Lastly, I agree with the previous comment that there should be a lip or indentation in the tray so that she is able to propel her chair without losing her things. Design looks great though!
>
> As this is a young girl, consulting her on color, graphic design (perhaps a stencil design that works at all angles on all four pieces?) and texture are likely to increase the usability of your products.
>
> While it would be practical to place the water bottle holder near her legs, I would consider social constraints that say food and drink are kept above the waist. It's normalizing and potentially more hygienic. If time and budget allow, you could consider the option of a reusable, cleanable flexible or "crazy" straw with a clasp that she could work to attach the mouth piece near her.

The students and advisory board members all reported that they were comfortable using the blog, and the feedback on the blog demonstrated a high level of interaction between the students and advisory boards.

Discussion

We found that there were a number of positive outcomes that resulted from implementing these advisory boards:

1. There was excellent interaction between the students and advisory board members. As is evident from the example above, the feedback was at a high level and provided a useful perspective from each group represented on the advisory boards. Whether the feedback was adding a new perspective or repeating our own concerns, it was helpful for the students to hear this advice from outside sources.

2. It was notable that several groups of BME students were interacting with their advisory boards remotely during spring break, a time period in which we do not anticipate the students will be thinking about their projects. This helped them to quickly resume their project work right after spring break.

3. The advisory board members reported that they were comfortable using the Wordpress blog, including those individuals who were not technically savvy. It was easy for them to watch videos and provide feedback using the built-in comments feature.

It is not possible to compare the success of any individual project with and without the feedback from an advisory board. However, before we implemented these advisory boards, students receive little feedback outside of the instructors, clients, and the client's health care providers. It is clear that now, the students are getting significant feedback on their design ideas from their advisory board. We also know that this feedback has resulted in useful modifications to the students' designs to help them achieve their goal of developing a device that is safe, durable, and meets the client's needs. Therefore, we are confident that this initiative has been a success.

Future changes

In the future, we will create additional opportunities for formal interaction between the advisory boards and BME students. Advisory boards will start giving feedback to the students earlier in the semester. The students' preliminary project proposal, developed in the first month of the class, could move to an online format, as we have done with the mid-semester presentation. We have also developed a rubric to assist the advisory board in the evaluation of the design ideas and prototypes.

In addition, we plan to include an assessment that evaluates the effectiveness of the advisory boards and their feedback to the students. This assessment will involve questionnaires to the students and the advisory board members. Through these changes, we anticipate that students will further benefit from their interactions with the advisory boards.

References

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