Extended Reality in Interprofessional Learning: Facilitating Engineering-Medicine Interactions (37)

Innovation/Demonstration Station: Including interactive or computer-based teaching (Some past examples include board games, software, and virtual reality.)

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Background:
The vision of this project is to develop extended reality (XR) tools that promote interprofessional learning by providing broad access for engineering students to collaborate with healthcare professionals. XR has been shown to be an effective tool in facilitating a variety of interactions, including in engineering and medicine. Currently, only a small fraction of BME students get meaningful exposure to the clinic and clinicians. The use of XR will increase access and throughput for our students to the clinical environment, and thereby will greatly enrich their training and their ability to be effective as engineers solving problems in medicine and healthcare.
The specific classroom challenges are as follows:
• The performance problem is that BME students need clinical exposure to gain the knowledge required to design new medical devices, but it is difficult to physically access the clinical setting.
• The learning problem is the gap in clinical knowledge and communication skills that are needed to interact with clinicians and to fully understand the clinical problem.
This project plays to the strengths of XR by i) visualizing the unseen through use of VR to examine anatomy inside the body, ii) immersing students in an authentic environment by teaming them with medical learners and using real medical images for the simulation.
The main impact of this project is an innovative teaching tool that enables remote but lifelike VR-based interactions between engineering students and medical learners. Achieving these interactions is difficult because of restricted access to the clinic, and these issues have been exacerbated by the pandemic. The proposed simulation modules would enable cross-disciplinary experiential learning methods that could be applied across the College of Engineering and beyond.

Actions, Methods or Intervention:
The initial version of the XR module was designed to be piloted in the Graduate Innovative Design in Biomedical Engineering course in the College of Engineering. The main elements of the module and learning exercise are:
i) Segmentation of medical images to visualize anatomy using the Mimics Innovation Suite (MIS) medical image processing software. Segmented images (STL or OBJ) are brought into a VR environment for enhanced flexibility in viewing, manipulating and discussing the anatomy and pathology presented in the image sets.
ii) Training and discussion on anatomy and surgical approaches in a virtual environment by student teams and surgical residents. Medical trainees will apply their knowledge to planning the surgery, and will explain the rationale for their approach to the engineering students. The VR environment allows manipulation of the anatomy and visual access to normally unseen structures.
iii) Presentation and discussion of the segmented image and associate pathology with the rest of the class, and with clinical experts. The final showcase takes place in a virtual environment designed and built by the project team. The goal of the final presentation is for the team to articulate their approach to designing a therapy for the specific human pathology, and to discuss this with clinical experts.

Results:
The first iteration of this XR Module was successfully run in Fall 2021. The module consisted of three class sessions that covered digital image segmentation and introduction to VR environments. Students worked on teams outside of class to prepare their VR project, and presented during the final showcase. Student teams demonstrated the ability to manipulate and discuss segmented digital models of human tissues in a virtual reality environment. All students completed both a pre-module survey covering their previous experience with XR and with interprofessional interactions, as well as a post-module reflection form that re-assess the pre-module questions and also allowed students to provide feedback on their

experience with the module. Preliminary analysis of the pre- and post-module feedback demonstrated that the XR module increased the comfort level of students in using VR, and also increased their comfort in using VR to interact with clinicians (see Figures). Overall, the module was successful and impactful, though we identified several technical and logistical challenges in the first iteration.

Lessons Learned:
A main learning from the first iteration of the XR module is that student teams needed more time to create rich VR environments. The students were clearly enthusiastic about creating and using these environments, but technical complications occurred frequently and required time for troubleshooting. The final showcase was exciting, but also revealed some technical challenges in having several teams present remotely in a VR environment. In addition, the focus on technology and interaction with clinicians made it difficult to also assess the degree to which the module assisted with interprofessional communication.

Future Application and Next Steps:
The first iteration of the XR Module was completed in mid-November 2021. During the Winter 2022 term, the data from the pre- and post-module questionnaires will be compiled and analyzed. The goals of this analysis are 1) to evaluate the effectiveness of the first iteration of the VR module in exposing BME students to XR, and 2) to identify areas of potential improvement for implementation in the second iteration of the VR module in Fall 2022. A debrief and planning session for the entire project team will be held during Winter 2022 to discuss progress and plans. It is expected that two main focus areas will be 1) addressing technical challenges in implementing large group VR exercises, and 2) improved engagement of surgical residents and other clinical staff to enhance interprofessional interactions.

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