Learning human anatomy is critical to medical students, but the learning process itself can be challenging. Students spend countless hours participating in traditional cadaver labs and studying physical anatomy models, atlases of anatomy, and digitalized image banks. Such traditional education practices have changed relatively little in the last few decades, and while these practices have advantages, they also have significant drawbacks. The cadaver-based learning approach has seen a decline due to practical, ethical, and cost issues. As a result, anatomical education has relied more on physical, diagram, and image models. The model approach introduces additional spatial learning challenges for students, including difficulties in (1) translating two-dimensional static images, diagrams, or photographs in medical illustrations to three-dimensional human bodies and (2) visualizing dynamic processes in a living organism, such as the activity of working muscles, from inanimate physical models.

In this project, we will develop and refine a new interactive, augmented reality (AR) learning tool for anatomy education. The tool combines the Magic Mirror system and Balaur Display Wall to produce “in-situ” visualizations of medical information directly on top of the student’s own body. A gesture-based user interface (UI) allows the student to directly interact with medical illustrations. As seen in Figure 1, a student standing in front of a large display screen sees an image of the small intestine projected onto his own torso (organ is outlined in yellow) and a more detailed cross-section of the organ is displayed in the right top corner. The student can select an icon on the right side of the screen via hand gestures to learn more about the organ’s functions or view other organs. The tool will create a personalized, self-paced, immersive learning environment for students.

Undergraduate and graduate students enrolled in anatomy courses will participate in a series of educational sessions with the AR learning tool. We will assess students’ learning by examining changes in their anatomy knowledge over time using knowledge assessments and course grades. We will examine the usability of the tool (e.g., ease, functionality) by exploring full-body tracking data, system event logs (i.e., learners' interactions in the system), and time required to complete assigned tasks in the system relative to their learning outcomes. Multimodal machine learning methodologies will be applied to analyze the data. This project will produce a new personalized educational tool for students learning human anatomy and will be the basis for future educational intervention work in this area. Moreover, this work has potential implications for the development of similar AR learning tools in other domains, such as rehabilitation exercise, and for other student populations (e.g., high school).

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