Preliminary Usability Analysis of an Augmented Reality Application to teach Anatomy

Devin Kelley, B.S, Jessyca Derby, M.S, Ana Gonzalez, M.S, Tara Fields, M.S, & Dr. Barbara Chaparro, Ph.D

EMBRY-RIDDLE Aeronautical University

Introduction

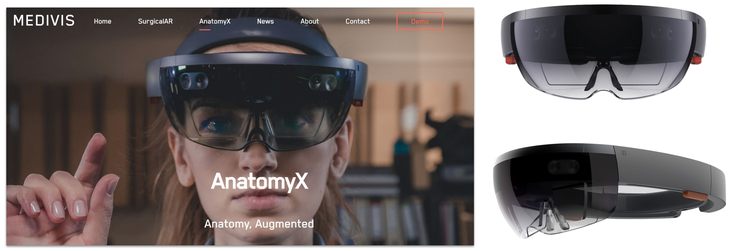

Figure 1. AnatomyX Application and Microsoft HoloLens Gen 1

- The Microsoft HoloLens is a hands free, augmented reality (AR) headset, which allows the user to interact with real-world elements that are also augmented by computer-generated information.
- AnatomyX allows users to virtually view and manipulate a replica of the human body.
- The application was designed as a scalable enterprise-level solution for any institution that teaches anatomy, and the content within is applicable to any student from the medical school level down to the high school level depending on the goals of the instructor and institution.

Current Study

- The purpose of this study was to assess the usability of the AnatomyX application by Medivis for first-time college student users.

Method

4 Participants (1 female, 3 male)

Figure 2. Demographics.

- Participants were asked to complete a background questionnaire on their personal AR usage.
- Once completed, they would go through a set list of tasks that were randomized (Table 1).
- After each task, participants rated the difficulty on a scale from 1-5.
- Following the tasks, participants completed the:
  - System Usability Scale (SUS)
  - Microsoft Product Reaction Card (MPRC)
  - Net Promoter Score (NPS)
  - Perceived Exertion (BORG CR-10)
- Participants also gave their opinions about the overall experience with AnatomyX.

Figure 3. HoloLens image mirrored on TV for researcher observation.

Table 1. List of the tasks that the participants completed.

	Tasks	Difficulty 1= easy
Task 1	Complete introduction tutorial	2.75
Task 2	You want to view how complex the human body is. View 5 different systems.	1.25
Task 3	**Imagine that you are studying components of the ear for an upcoming exam. View the ear so you can see all of the structures in more detail.**	2.5
Task 4	After an upper body workout you are interested in taking a closer look at 2 different regions.	1.5
Task 5	You are studying the reproductive system and how they differ in genders. Find the female ovaries.	1.75
Task 6	**You are learning about the respiratory system and what affects it, such as bronchitis. Use a voice command to see this system in more detail.**	2.5
Task 7	You want to get a closer view of the human body, place it in supine mode.	2.25
Task 8	**Imagine you have learned that different areas of the brain control different functions, isolate the brain to view the frontal lobe.**	2.75
Task 9	Your back is stiff. View the back of the body to see which muscle might be causing this.	1.25
Task 10	After a long day of walking, the arch of your right foot is hurting. What specific muscle may be affecting that?	2.5
Task 11	Find and complete a pre-test (randomly assigned: muscular system, skeletal system, or eye and ear)	2.5
Task 12	After you completed that pre-test, you want to view that system in more detail.	2
Task 13	Complete Post-Test	1.5

***Bolded tasks are those that were most difficult/least successful.**

Figure 4. Viewing components of the ear.

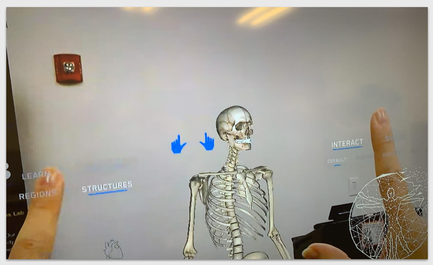

Figure 5. App displays how hands should be placed, but does not display how to select.

Results

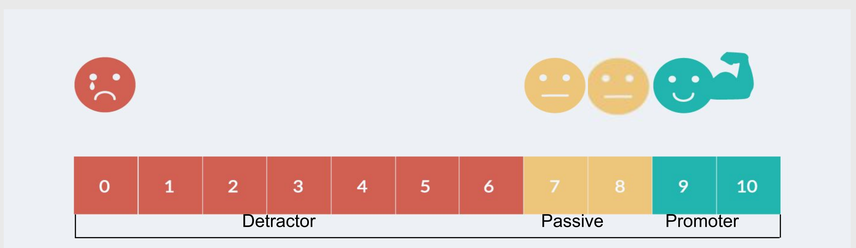

Figure 6. How likely a participant would recommend the AnatomyX.

Results Continued

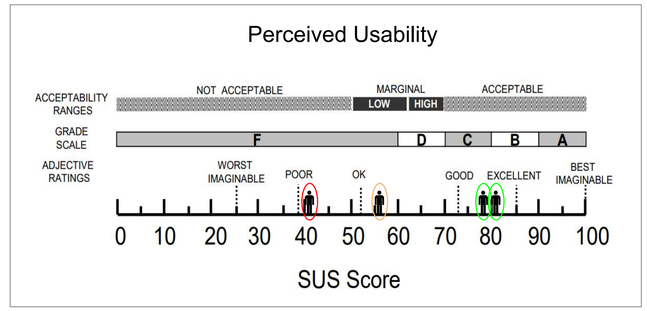

Figure 7. Perceived usability scores from each participant.

Figure 8. Descriptive Adjectives given about the look and feel of the application.

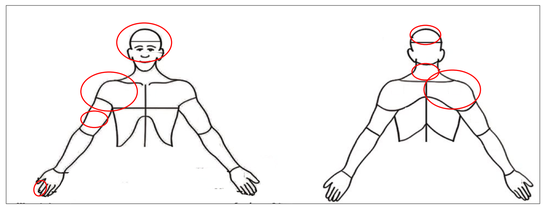

Figure 9. Perceived Exertion: Areas of most exertion.

Discussion

- Participants reported the AnatomyX application has very good learning capabilities.
- Participants enjoyed the visual/3D effects (Figure 4).
- Participants had difficulty moving the body around (Figure 5).
- Participants liked that the application provides an intuitive way to look at the human body.
- Challenges included resizing the body, and accurately aiming the cursor that is aligned with your head.
- Participants noted fatigue in their arm from gesturing and in their head region from wearing the device for long periods of time (Figure 9).

Future Research

- Complete usability analysis on next version of the application designed for the HoloLens 2.
- Evaluate the learnability of the content as it compares to traditional methods using a college-level anatomy class.

References

- Brooke, J. (1996). SUS-A quick and dirty usability scale. *Usability evaluation in industry, 189*(194), 4-7.
- Nerys Williams, The Borg Rating of Perceived Exertion (RPE) scale, Occupational Medicine, Volume 67, Issue 5, July 2017, Pages 404–405
- Küçük, S., Kapakin, S., & Göktaş, Y. (2016). Learning anatomy via mobile augmented reality: effects on achievement and cognitive load. Anatomical sciences education, 9(5), 411-421.