Interactive Life Sized 3D Digital Modeling & Simulation: A Case Study in Anatomy and Physiology Education

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Abstract: 3D digital simulation and related educational technology represent a relatively new phenomenon in clinical health sciences and STEM education. When such technology is leveraged to prepare students for clinical and science related encounters, it should map back to the curriculum and strive to solve challenges associated with traditional didactic instructional techniques (Bauman & Ralston-Berg, 2014). The *AnatomyTable* provides an interactive large format 3D touchscreen experience to reinforce anatomy and physiology objectives for veterinary medicine students.

Background

3D digital modeling and simulation is not a new phenomenon and has been used in various experientially driven curricula (Kolb, Kolb, Passarelli, & Sharma, 2014). Advances in technology have the potential to encourage increased interactivity and engagement of and among learners. The project discussed in this paper addresses the design process related to the development of life sized 3D digital modeling and simulation, as well as the pedagogical paradigm shift required to leverage such technology. The *AnatomyTable* was designed to address the challenges of teaching comparative and veterinary anatomy. While this paper discusses this technology through the lens of comparative and veterinary anatomy, the researchers and designers believe that this type of interactive large format 3D modeling and simulation technology could also be leveraged for a variety of other topics, particularly STEM education. Technology should be integrated within existing curricula with purpose and to solve problems or challenges associated with traditional educational models. To this end content conveyed through the use of novel technology such as digital simulation must map to the objectives found within the curriculum.

Summary of the Project

Teaching anatomy can be particularly challenging and must attend to various ethical and logistical concerns. When using animal models for teaching purposes one must attend to accepted animal welfare standards. In addition, traditional models of anatomy education are limited in terms of access to specimens and the ability to contextually situate anatomy lessons in an applied context (Martinsen & Jukes, 2005). More accessible 2D images or textbooks do not adequately demonstrate the spatial relationship of complex structures, spaces, or orientation (Adams & Wilson, 2011).

AnatomyTable provides a high-fidelity interactive 3D life sized canine model displayed on a large touch screen. This model can be dissected layer by layer and by body system. Students are also able to explore physiological events and complete virtual surgical techniques based on objectives found throughout their curriculum. *AnatomyTable* also allows faculty to link course notes directly to students interactive experiences in real time. Focus groups were conducted to evaluate acceptance of this technology to support existing curriculum and to glean feedback for *AnatomyTable* enhancements. The research and design team hypothesized that students would be accepting of the technology.

Theory

The development of *AnatomyTable* is fundamentally anchored in the concepts of a layered learning approach to clinical education and educational technology implementation. Didactic components of the curriculum are reinforced through scaffolding multimedia educational experiences, while simultaneously providing authentic situated learning opportunities to move students towards eventual clinical practice and competency (Bauman et al., 2014). The layered learning model, Figure 1, illustrates how a multi-medium approach supports educational activities preparing clinicians (human or veterinary) for real world experiences.

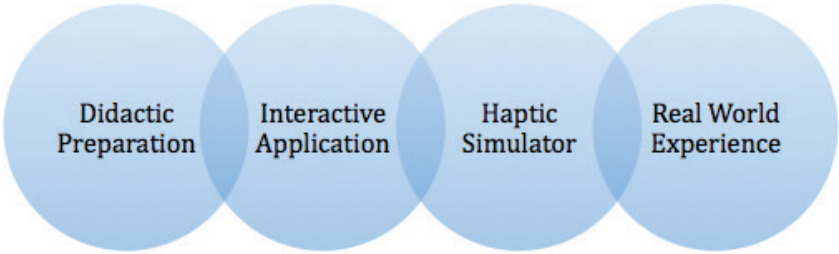

Figure 1: Layered Learning Model. © E.B. Bauman 2014.

The layered learning model recognizes the importance and relevance of traditional facets of education. Digital applications and virtual reality are not seen as replacements for lectures, or reading assignments, but rather as tools to support a transition from the classroom to the clinic. In other words, students still engage traditional didactic preparation, such as lectures, reading assignments to prepare for more interactive components of the educational process. Didactic preparation prepares students for and overlaps with interactive situated learning activities that represent and portray authentic clinical practice.

For the purposes of this project, digital games and simulations represent the *AnatomyTable* and haptic simulators represent traditional veterinary cadaveric dissection. Students continue to develop content and process knowledge though game-play, which in turn prepares them for supervised learning opportunities with physical simulators or physical specimens (Bauman, 2007; Bauman 2010). Learning that leverages digital interaction and interaction taking place with simulators or specimens prepares students for supervised clinical education in actual clinical environments where students interact with real patients.

Methods

A convenience sample of 66 veterinary medical students was recruited to watch a brief demonstration of the *AnatomyTable* and then spend approximately 20-30 minutes interacting with the *AnatomyTable*. At the conclusion of the interaction, the students filled out a questionnaire related to their experience. Students completed this process in small groups of approximately 2-5 students at a time. The Ross University School of Veterinary Medicine IRB approved this study and students were provided with informed consent prior to data collection. All data collection was completely voluntary. Students were provided with a $20 gift certificate for the campus coffee shop as an incentive for their participation.

Results

A convenience sample of 66 students was surveyed. 95% found *AnatomyTable* Very Helpful (n=39) or Somewhat Helpful (n=24); with 50 (66%) Very Willing to use it and 14 (21%) Somewhat Willing to use it. Finally, 40 students (61%) were Very Satisfied with *AnatomyTable* and 14 (21%) Somewhat Satisfied.

Qualitative results form open-ended questions were consistent with quantitative results.

Discussion

The researchers believe that the data presented here provides an impetus for the inclusion of high-fidelity large format interactive 3D digital simulation for clinical and STEM education. However, when considering such implementation it is critical to consider not just appeal, but effectiveness and efficiency as well (Ralston-Berg & Lara, 2013). Design processes that ensure innovative technology targeted for educational purposes should be effectively grounded in curricular goals and learning objectives. Further, it is imperative that technology intended to support clinical and STEM education serve to solve problems existing within the curriculum in order to promote greater adoption potential among students. In short, if students do not perceive technology as effective and efficient, it is unlikely to be used (Bauman and Wolfenstien, 2012). AnatomyTable and other like technology encourage active engagement and team problem solving. Team problem solving is a demonstrated effective method for clinical education (Hazel, Heberle, McEwen, & Adams, 2013; Hrynchak & Batty, 2012). While it is thought that students are accepting of the technology presented, teachers and researchers alike should understand that further investigation is required to determine if this sort of digital technology has an effect on learner outcome.

Conclusion

Students in this study were accepting of the educational technology discussed in this paper as a tool to support their existing curriculum. Further, the researchers found that the focus groups and the subjects completed questionnaires provided important feedback for technology and content enhancement.

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