USING IMMERSIVE TECHNOLOGIES TO ENHANCE STUDENT LEARNING OUTCOMES IN CLINICAL SCIENCES EDUCATION AND TRAINING

Richard Kalunga[1], & Fatma Elshobosky[2]

[1]Divsion of Education, Health, and Social Work, University of the District of Columbia (USA)
[2]Center for the Advancement of Learning, University of the District of Columbia (USA)

Abstract

In recent years, the development of immersive technologies has progressed significantly, becoming more accessible and emerging as a fundamental change agent in how we will engage across all levels of society. These technologies are already being used in the workplace for various functions and for leisure and everyday life. They are recognized as the most disruptive technology of the next decade, with healthcare and education being amongst the most disrupted fields. Emerging research shows that Virtual Reality (VR) offers potential advantages for educational simulation and therapeutic intervention because of its ability to capture and recreate content and interactions in virtual environments. Through three-dimensional rendering of environments that incorporates visual, auditory, tactile and/or kinesthetic elements, VR presents unique opportunities to improve educational outcomes through increased engagement, enriched learning experiences and improved understanding, and increased knowledge retention. Given these potential benefits and inevitable proliferation of VR, particularly in highly experiential health-related fields with clinical components, we undertook to introduce immersive technologies into the speech-language pathology program curriculum and collect data on perceived impact on student learning. This study outlines the activities undertaken and examines aspects of integrating immersive technologies into an educational curriculum such as faculty and student attitudes on the usefulness of these technologies within a particular field, perceptions on the effectiveness of immersive technologies in increasing educational and training outcomes, availability and access to immersive technologies and software that meet defined educational needs, and adaptability of these technologies to meet specific learner and educational considerations. Ultimately, the purpose of this study is to spur discussion and exploration of the use of immersive technologies, particularly VR, across a variety of disciplines to advance student learning outcomes.

Keywords: Innovation, technology, immersive technologies, virtual reality, clinical sciences.

1. Introduction

The development of immersive technologies has progressed significantly and as they have become more accessible, they have emerged as a fundamental change agent in how we engage across all levels of society. Already in use in everyday life, for leisure, and in the workplace for various functions, they are now recognized as the most disruptive technology of the next decade, with healthcare and education being amongst the most disrupted fields. The need for effective teaching and learning pedagogies and clinical approaches in clinical sciences education calls for the use of innovative educational and clinical tools. Immersive technologies offer one such tool. Immersive technologies blur the line between the real and virtual worlds, allowing users to feel fully immersed in the experience (Suh & Prophet, 2018). It is a broad term that encompasses virtual reality (VR), augmented reality (AR), mixed reality (MR), and extended reality (XR) technology (Suh & Prophet, 2018). Immersive technologies such as VR offer potential advantages for educational simulation and therapeutic intervention because of the ability to capture and recreate real-world content and interactions in virtual environments. Three-dimensional rendering of environments that incorporates visual, auditory, tactile and/or kinesthetic elements presents unique opportunities to improve educational and clinical outcomes through increased engagement, enriched learning experiences and improved understanding, and increased knowledge retention. Research in different areas, such as health care (Kobayashi et al., 2018; Zhao et al., 2016), education (Calvert & Abadia, 2020; Frank & Kapila, 2017), and crisis management (Kwok et al., 2019; Morelot et al., 2021), shows that immersive technologies could improve learners' learning

experience and promote their cooperation and creativity in classes. Given this background, scholars from varying fields have sought to identify different ways and application domains to use immersive technologies to train health care professionals, including students. However, there is relatively little research to explain what is known and what is necessary to know about the integration of immersive technology into educational and clinical curricula (e.g., processes and supports, content areas, technical and staff capacities, barriers, performance, evaluation, and sustainability). Given the potential benefits and inevitable proliferation of immersive technologies, particularly in highly experiential health-related fields with clinical components, this study undertook to provide a framework for successful integration of immersive technologies into clinical sciences education by systematically integrating these technologies into the speech-language pathology program curriculum and collecting data on perceived impact on student learning.

2. Methods

The Master of Science Degree Program in Speech-Language Pathology at the university of the District of Columbia partnered with the University's Center for Advancement of Learning to pilot a program to systematically and comprehensively integrating immersive technologies into the curriculum. The Center for Advancement of Learning (CAL) works with faculty, staff, and administrators across the University's colleges, divisions, and campuses to incubate, advance, and upscale initiatives that promote effective learner-centered instruction and course design that is inclusive and innovative. The Speech-Language Pathology (SLP) Program, with its integrated academic and clinical components, presented a unique opportunity to develop a template for effectively integrating immersive technologies into a variety of programs within the University. It is deemed essential to leverage these technologies to be part of the University's learning ecosystem since immersive technologies are expected to play an important role in the future of education, enhancing STEM courses, medical simulations, arts and humanities courses, and technical education.

The SLP Program and CAL developed a plan of action for the implementation of immersive technologies into the curriculum that was focused on attaining synergistic integration, was sustainable and responsive to changing Program and student needs, enhanced student learning and clinical competency, was evidence-based, and had the support of faculty and students. The implementation plan was faculty driven, involving: 1) determination of initiative goals and objectives, 2) extensive curriculum review to determine optimal course sequence for implementation, 3) faculty training to enable implementation of immersive technologies in course activities, 4) alignment of initiative goals and objectives with Program, College and University goals and objectives, and 5) data collection and feedback through surveys and focus groups to inform the process. Central to the plan was a commitment to learning from the process and dynamic problem-solving driven by discipline-mediated processes. Program faculty and CAL personnel undertook detailed and comprehensive appraisal of available hardware and software that could support program goals and identified processes for maintaining immersive technologies assets, hardware, and software. The stages of implementation included: 1) faculty training and continued support, 2) development and launch of a learning module introducing students to the use of immersive technologies in education and clinical practice, 3) in-class experiential actives where students received hands on experience using various immersive technologies for educational and clinical application, 4) student engagement with industry innovators in the commercialization of virtual reality in clinical settings in the field of speech-language pathology, and 4) student exploration of available immersive technology resources for use in speech-language pathology and those that, though not designed for the field, offered potential use application. Students were surveyed on their attitudes on the use of immersive technologies in the curriculum, as well as their engagements around immersive technologies both before and after study implementation.

3. Discussion

Surveys and focus group discussions revealed positive trends regarding the effectiveness of the engagements on immersive technologies undertaken under this initiative in achieving targeted goals and objectifies, providing support for the integration of these technologies into the speech-language pathology (SLP) curriculum. Survey of student attitudes on use of immersive technologies in the SLP curriculum before and after participation in the immersive technologies in SLP learning module showed positive shift in favor of adoption of these technologies for academic and clinical use. In describing how interested students were in instructors using immersive technologies for teaching in SLP courses and clinic, student sentiment shifted from mostly "somewhat interested" to overwhelmingly "very interested". There was also a corresponding increase in the number of students who thought incorporating immersive

technologies in SLP program courses would enhance student learning. Participation in the immersive technologies in SLP learning module also resulted in bolstering of the perceived benefits of incorporating immersive technologies in SLP courses. These included allowing students to test real-world lessons in low-risk situations, allowing students to better visualize difficult or abstract concepts, motivating students to learn, and imparting important technical skills necessary in the 21st century workforce. The trend of higher post- vs pre-engagement numbers was not observed in the areas of encouraging creativity and offering students more personalized learning, although these areas were still identified as being benefits of using immersive technologies in instruction. This might be an artifact of the type of engagements that were presented. These survey findings provide supportive evidence for the potential benefits of integrating immersive technologies into clinical sciences program curriculum.

Additionally, the study provides a framework for successful and sustained integration of immersive technologies into a curriculum, rooted in faculty and student buy-in and participation from the earliest stages, responsiveness to faculty and student feedback, and the use of that feedback to help determine immersive technology assets selection, program processes, and the pace of integration. Features of the integration process included adoption of a dynamic process sensitive to the changing realities of available immersive technology assets, their functionality relative to program goals and objectives, and adequacy of available technical support for implementation and sustainability. The framework also recognizes and leverages the value to student learning, motivation, and engagement derived from involving students as partners in envisioning and shaping use cases for the technologies within the discipline. Because the framework is guided by and responsive to the specific needs of the academic program, it provides a template for successful integration of immersive technology in a wide variety of disciplines. A necessary component of the initiative is the need to cultivate ongoing and robust synergistic collaboration and sharing of expertise between discipline faculty and university technology services to facilitate the generation of novel ideas and dynamic approach to problem-solving that is essential for successful conceptualization and execution of the program.

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