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The Effectiveness of Virtual Reality in Distance Learning

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Abstract

As technology advances, we may expect to see a larger use of mixed reality technologies, including virtual reality (VR), being embraced as learning tools to be used in distance learning. The SARS-COV-2 coronavirus pandemic shuttered academic instructions in the Spring of 2020. During this time educational technologies, including VR technologies, were embraced as education leaders rushed to pivot from the traditional lecture-based in-class learning to a more dynamic remote distance learning strategy. This paper discusses the efficacy of virtual reality implementation within a digital learning environment to promote social presence, communal learning, and increased student learning outcomes.

Keywords: distance learning, virtual reality, social presence, online learning, community, experiential learning, practical application, virtual learning environments

The Effectiveness of Virtual Reality in Distance Learning

This paper discusses the efficacy of virtual reality implementation within a digital learning environment to promote social presence, communal learning, and increased student learning outcomes. The guiding question for this research was: Does the integration of virtual reality in distance learning increase social presence and learning outcomes? The literature for this research has been broken down into the following content sections: virtual reality, learning outcomes and practical application, social presence, distance learning.

Literature Review

Virtual Reality

In 1968 Ivan Sutherland was the first to coin the terms for what is considered today to be the definition of virtual reality. His concept was described as a realistic virtual world viewed in real-time as experienced through a head-mounted display (HMD) which allowed users to react and respond to 3D assets in a way where one cannot tell the difference between the real and virtual world (*History of Virtual Reality*, 2017). Technology has come a long way since 1968 and developers have been expanding on Sutherland's Virtual Reality concept.

Virtual reality (VR) technology immerses the user within an artificial environment (Elmqaddem, 2019). "VR has the potential to act as an active learning tool and enhance the educational experience in bioscience, as it encourages active participation and self-directed learning of a student through high-levels of interactivity with the software" (Fabris, 2019, p. 71). While virtual reality may appear to be the future of education, implementation of VR technology in higher education has been historically slow to employ.

McGovern et al. (2019) suggest that the resistance of virtual reality adaptation in the higher education sector was due to two main factors: the inability of universities to fund the

investment needed to support innovative hardware and software, and the professors' inability to embrace the technological changes required to meet the changing student expectations. Fabris (2019) reports that software titans such as Facebook, Google, and Apple have invested in the development of mixed reality technologies, and with the Oculus Go headset at a customer price point of around $200, administrative funding concerns have decreased. Purchasing the required hardware has become more affordable for universities (Fabris, 2019).

In 2020, preservice teachers participated in a survey inquiring to what extent they would potentially implement virtual reality within their future lessons. While the enjoyment factor received the highest rating for potential implementation, preservice teachers also noted that VR could be useful for teaching within their schools (Bower et. al, 2020). However, in the qualitative post-survey interview, preservice teachers also noted that school administration and leadership are considered a perceived challenge for the adoption of mixed realities in education. Bower et. al (2020) reports that to make such a technology shift in the education paradigm, the school administration would need to provide technical support and training, as well as invest in the technology and infrastructure to support it.

Learning Outcomes and Practical Application

In 1956 Benjamin Bloom developed a taxonomy identifying the intellectual learning behaviors of the cognitive domain. What came to be known as Bloom's Taxonomy identified lower-order thinking skills, which progressively advanced into higher-order thinking skills. Bloom's Taxonomy started with the lowest level of Knowledge, and then progressed to Comprehension, next was Application, and then Analysis, and Synthesis, followed by the highest level of Evaluation (Churches, 2008). Toward the end of the 20th century, Anderson and Krathwohl revised the original Bloom's Taxonomy to go from Remembering, to Understanding,

to Applying, to Analyzing, to Evaluating, and ending with Creating (Churches, 2008). Educational virtual reality experiences need to be developed with learning objectives at the forefront of development, with a framework in place to assist students in the learning process (Fabris, 2019).

In a study conducted by Parmar et al (2016) researchers compared the psychomotor skills of learners interacting with educational content via a desktop-based virtual reality application, as compared to a head-mounted display VR experience. The experiment revealed that while learners were able to successfully achieve all levels of Bloom's Taxonomy, the learners utilizing the head-mounted display interaction understood the task considerably better than the learner using the desktop application. More specifically when considering one of the highest levels of Bloom's Taxonomy, Evaluation (Parmar et al, 2016).

Activities and opportunities for experiential learning and self-directed discovery help adult learners understand new concepts. As suggested by Knowles, 1977 andragogical learning should be self-directed, collaborative, and promote decision-making opportunities with experiential learning activities. Education should be designed with a focus of assisting the learner by providing learning experiences that will help the learner develop competency, rather than merely absorbing content (Knowles, 1977).

Kolb (1984) identified the working definition of learning as: "Learning is the process whereby knowledge is created through the transformation of experience (p. 38)." Knowledge is, in part, obtained through the process of personal experiences. These personal experiences identify change and support growth in human knowledge. Identified as Experiential Learning Theory (ELT), the idea that knowledge is based on experiences, Kolb contends that learning is a determining factor of humanity (Kolb and Kolb, 2005). Experiential learning builds on the

learner's prior knowledge and experiences to leverage their internal motivation and educational interests (Kolb et al., 2014).

Through virtual reality, learners can converse in real-time thereby creating human connection, virtually. Kolb and Kolb (2005) identified that humans learn naturally through conversations. Using experiential learning opportunities within a virtual reality environment, learners can connect with the learning content, the instructor, and their peers, therefore increasing the potential learning outcomes.

Social Presence

Social presence within a digital environment can increase student performance (Hostetter, 2013). Riva et al. (2014) define presence as "the pre-reflexive sensation of "being" in an environment, real or virtual, which results from the capacity to carry out intuitively one's intentions within that environment" (p. 14). Social presence is the feeling of being with other individuals in either a real or virtual environment (Riva et al., 2014).

Mennecke et al. (2011) expands on the research of social presence theory and presents embodied social presence (ESP) theory to identify how presence and copresence can be defined through shared virtual environments. Virtual experiences, interactions, and a sense of social awareness are viewed in a first-person perspective. ESP suggests that individuals can become one with their virtual avatars in a virtual environment (Mennecke et al., 2011).

Qualitative data analysis on ESP theory revealed that 68% of students achieved a sense of embodied social presence within the virtual environment (Mennecke et al., 2011). Students expressed the feeling of being psychologically immersed with their digital-self and communicated with others expressed improved interaction with their classmates. Increased

awareness of embodiment, as identified through ESP, is enhanced through collaborative multiuser activities and combined experiences (Mennecke et al., 2011).

Social presence can be demonstrated by the instructor by providing prompt feedback to students, using student names, and expressing feelings and humor as applicable (Hostetter, 2013). Riva et. al (2014) elaborates on the importance of social presence to communities with the virtual environment enhancing the group dynamic. Communal social presence within a digital environment can promote identity and belonging, participation, empathy, and support (Riva et al., 2014). Hostetter (2013) noted that students who demonstrated a higher level of social presence achieved better marks on course assessments.

Distance Learning

In a position paper, Pietroszek and Lin (2019) argue that virtual reality can be considered a potential medium for students to experience remote classroom instruction. Their VR classroom experiment, UniVResity, allowed students to embody an avatar and attend class virtually with a head-mounted display. Student avatars could speak in real-time and interact with the instructor. Students could be called to the interactive whiteboard at the front of the class, and their avatar would appear at the front of the class. Student feedback from the experiment was extremely optimistic, noting that the interactions in VR were more exciting than attending class via videoconference (Pietroszek and Lin, 2019).

Won et. al (2020) discovered that students desired a need for social connection and that interactions within the virtual reality environment can promote the feeling of connectedness among classmates and instructors. In a study designed to gauge student experiences of remote learning within a virtual reality environment, researchers led classroom lectures and activities through three different virtual reality environments (Won et. al, 2020). Students had the option to

attend the virtual class through an immersive head-mounted display or via a web browser from their computer. In a final summary survey, students expressed that they felt closer to their peers when immersed in the virtual environment. One student stating: "With zoom, most of my classmates didn't speak or have their videos on, so I didn't feel connected to them in any way. In the virtual environments, I saw their avatars moving and people were more willing to talk or chat, so it felt more authentic than Zoom." (Won et. al, 2020, p. 379).

Discussion

While the expense of virtual reality hardware and software continues to be noted as a challenge for institutions the cost of VR technology has recently dropped dramatically with new HMD technology incorporating eye tracking, hand scanning, and wider fields of view (*History of VR*, 2017). Fowler (2014) argues that additional research should also be conducted to bridge the connection between technology and pedagogy as it relates to virtual learning environments. Additional clarity should also be delineated: "The problem with using the term "immersion" is that it is being used both technologically, psychologically and now pedagogically" (Fowler, 2014, p. 417).

Conclusion

There is still much research that needs to be done on the topic of virtual reality, especially as it relates to education and pedagogy. Much has changed in the last 53 years since Ivan Sutherland devised the term "virtual reality". The virtual reality of today has reinvented the way students can interact and has given a new meaning to the word "immersion". Virtual reality interactions can increase social presence in digital learning environments thereby nurturing the learner's feeling of belonging, while also increasing participation, empathy, and support. Through active and experiential learning within a virtual reality environment, learners can

increase their level of understanding, thus achieving course learning outcomes. This research

concludes that the integration of virtual reality applications within a distance learning curriculum

can increase social presence, as well as learning outcomes.

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