

Using VR for Collaborative Learning: A Theoretical and Practical Lens



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INTRODUCTION

The first known head-mounted, virtual reality display, nicknamed “the Sword of Damocles”, was developed by Ivan Sutherland in 1968. Most notably, this early hardware allowed for the display to change perspective in the virtual world as the user moved his/her head (Mazuryk & Gervautz, 1999). Since then, the-head-mounted displays have gone through many iterations, including Thomas Furness’ Visually Coupled Airborne Systems Simulator (VCASS), Virtual Visual Environment Display (VIVED), and recently Google Cardboard, and Oculus technologies. Virtual reality differs from other types of virtual environments such as virtual world. According to Xie (2010), virtual world is usually computer-based, and users interact with the world by controlling avatars whereas VR completely immerses users within a simulated realist environment by replacing the immediate surroundings. Gigante (1993) classified head-mounted virtual reality as “the illusion of participation in a synthetic environment rather than external observation of such an environment. VR relies on a three-dimensional, stereoscopic head-tracker display, hand/body tracking and binaural sound. VR is an immersive, multi-sensory experience” (p. 4).

BACKGROUND

Due to the unique features and increasing affordability of the head-mounted VR tools, practical applications and research studies sprouted in recent years. Besides studies leverage VR tools to promote academic learning in various disciplines (e.g., Ahn et al., 2016; Lee et al., 2017; Lisichenko, 2015; Xie et al., 2021), studies also examined the efficacy of features provided by the tool itself, for example, the ability of manipulating objects in the virtual space (Jang et al., 2017), the ability to see the world as the participant moved their head and body (Orman et al., 2017). Yet, most of these earlier applications leveraged VR tools in a non-social, user-alone manner. In other words, each user interacts with the environment alone without socializing with other users while immersed in the virtual reality, mainly due to technological limitations. Such a drawback, however, would be mitigated with the availability of newer platforms, such as Spatial, which allows for life-like human avatars to be embodied, controlled, and voiced by actual people rather than computer-generated avatars (Spatial Systems, 2021).

DOI: 10.4018/978-1-6684-7366-5.ch040

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Focus of the Article

Due to the lack of a theoretical foundation to elucidate the learning processes within a collaborative VR environment, this chapter first establishes a working framework of how to facilitate VR-based collaborative learning through an aggregated lens including social translucence and embodied cognition. To help contextualize VR tools' ability to facilitate collaborative learning, three current virtual reality platforms are then evaluated in terms of collaborative potential. Based on analyses of a number of collaborative virtual reality studies, the chapter also provides recommended best practices for facilitating and designing collaborative virtual reality learning experiences.

Building a Theoretical Foundation for VR-Based Collaborative Learning

Since collaborative learning via VR tools is still a novel phenomenon, no established single theory or model could offer a thorough explanation of the learning process. However, many theories or conceptual frameworks referred to team collaboration, or technology-assisted collaborative activities, esp. in the field of organizational psychology (e.g., Colbry et al., 2014; Olson et al., 2013; Schulze & Krumm, 2017). In the effort to build a theoretical foundation toward a conglomerated view about how VR tools could facilitate team-based collaboration, in the section below, we explore a few theories and highlight the important theoretical concepts relevant to the phenomenon.

Root of Collaborative Learning Theory

The concept of collaborative learning originated from Vygotsky's (1978a, 1978b) sociocultural theory. Built on the assumption that learning is a constructive process, collaborative learning refers to an instructional strategy in which students of various abilities work in small teams toward one joint learning goal. The learning activities can vary, such as content comprehension, discourse advancement, problem solving, and product creation etc. Contrast to independent work, mutual understanding and interdependency are the fundamental key factors for any successful collaborative learning experience (Doolittle, 1997). As a result, finding effective communication channels and approaches to facilitate group interaction has been highlighted in the field of educational technology.

Technology-assisted Collaboration

The ever-changing and wide availability of novel technologies in recent years have inevitably brought about new opportunities and challenges to group interactions in collaborative learning situations (Karpova et al., 2009). Computer-mediated communication tools allow for a relatively easy and efficient way to exchange text, graphic, voice/audio, video, and most recently 3-D contexts or environments such as those in virtual reality. Since technology tools were not created equally, they provide different affordances for collaboration or collaborative learning.

Research found that in a text-based collaborative learning environment enabled by discussion boards and Google Docs, students agreed that there were a lot of quality interactions when actively engaged (Driver, 2002; Cundell & Sheepy, 2018). However, when there were few resources or technologies tools available, students experienced challenges in terms of communication, participation, accountability, and cohesive interaction (Bakir et al., 2020). Audio-based technology tools such as conference calls allow team members to converse collectively in real time. However, due to absence of circumstantial cues

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