

Chapter 51

Exploring 3D Immersive and Interactive Technology for Designing Educational Learning Experiences

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ABSTRACT

The purposes of this chapter are three-fold: to (a) review the research on 3D immersive and interactive technology (or virtual reality, VR) conducted so far for educational purposes both in the earlier years of the technology and in more recent years, (b) discuss a few VR technology tools available today, and (c) describe three scenarios in science, mathematics, and language learning to demonstrate how the current VR technology can be designed for education. In addition, primary challenges of using 3D immersive and interactive technology in education are also discussed along with future research directions. The intent of this chapter is to provide ideas and insights for researchers and designers who are interested in applying the VR technology in education.

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INTRODUCTION

3D immersive and interactive technology (or virtual reality, VR) has been around for more than 40 years. The first head mounted display VR system is credited to Ivan Sutherland in 1968 (New World Encyclopedia, 2008). Sherman and Craig (1995) defined VR as “a medium composed of highly interactive computer simulations that sense the user’s position and replace or augment the feedback of one or more senses – giving the feeling of being immersed, or being present in the simulation” (p. 37). In the first two decades, the complexity of VR technology components and the high cost associated with it limited the adoption of the technology and therefore such technology was only accessible to a few well-funded research laboratories and government laboratories. NASA, for example, used it for Hubble telescope training purposes in the 1990’s. Oil and gas research laboratories capitalized on the technology to supplement their oil and gas exploration efforts.

Recent advances in VR related hardware technologies have significantly lowered the cost of VR setup, opening up the possibility for its wider adoption. The game industry has been trying to develop a new genre of games based on VR technology with the availability of low cost hardware components. As an example, the game industry has released a free version of Unity3D that can be used to develop high quality VR applications. The combination of the low cost VR hardware and a free version of a popular VR software development platform (e.g. Unity3D) offers new possibilities and opportunities for considerations of creating immersive educational experiences that were previously too costly or not imaginable.

The purposes of this chapter are three-fold: to (a) review the research on 3D immersive and interactive technology (VR), with a focus on current and former educational applications and implications, (b) discuss several examples of VR technology available today, and (c) describe possible applications of the current VR technology in education, specifically in the subject matter areas of science, mathematics, and language learning. We also examine the design considerations for using these VR tools.

BACKGROUND

Research on 3D Immersive and Interactive Technology in Education in Early Years

Two major components of VR technology are the immersive display technology and 3D interaction technology. Most research activities in the field of VR have revolved around these two fields. Researchers have been trying to develop immersive display systems capable of supporting minimal visual requirements needed for the viewer to achieve immersive visualization. In addition to the visual requirement, the display system will also need to be comfortable for the user. Researchers face both hardware and software challenges. First, the VR hardware must be able to detect user interaction in a 3D space, and second, the interaction paradigm of the software needs to be addressed. Whereas a unified interaction paradigm already existed for the 2D applications running on a desktop computer, also known as WIMP (Windows-Icons-Menus-Pointer), there has not yet been a unified 3D interaction paradigm for developing all 3D applications (Van Dam, 1997; Jankowski & Hachet, 2013).

Several national and international research projects have shown interactive and immersive experiences can engage students in understanding various science concepts. The NSF-supported Science Space Project (RED-9353320), for example, researched the usefulness of using 3D interactive and immersive

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