

Chapter 6

Web-Based 3D Virtual Learning Environments

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ABSTRACT

This chapter is an overview of web-deliverable three-dimensional (3D) virtual learning environments. In Section 1 (Introduction) we define Virtual Reality (VR) Technology and Virtual Learning Environments; in Section 2 (Virtual Environments and Learning) we discuss literature findings on the benefits of using web-based VEs for self-discovery learning. In Section 3 (Developing online VE: technologies, challenges and solutions) we give an overview of the latest technologies/platforms used to develop online VEs, discuss development and delivery challenges posed by complex, information-rich web-based 3D environments, and describe possible solutions that can be adopted to overcome current limitations. In Section 4 (A review of two projects) we present two 3D web virtual learning environments that were recently developed by the authors: the Interactive 3D Tour of MSHHD and The pilot postgraduate medical education program in Second Life. A summary and conclusive remarks are included in section 5 (Summary and Conclusion).

INTRODUCTION

VR is a technology that allows users to explore and manipulate computer-generated, three dimensional, interactive environments in real time. VR is based on the theory that people do not experience reality directly, they receive a series of external

stimuli which are interpreted by the brain as reality. “If a computer application can send the same external stimuli that the brain can interpret, then the simulated reality is potentially undistinguishable from reality” (Sherman & Craig 2003).

A web interactive Virtual Environment (VE) is defined as a web-deliverable designed “information space in which the information is explicitly

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represented, educational interactions occur, and users are not only active, but actors (i.e., they co-construct the information space)” (Dillenbourg 2000). VEs offer three main benefits: (a) representational fidelity; (b) immediacy of control and high level of active user participation; and (c) presence. “(a) Representational fidelity refers to the degree of realism of the rendered 3D objects and the degree of realism provided by temporal changes to these objects. (b) User control and high level of participation refer to the ability to look at objects from different points of view, giving the impression of smooth movement through the environment, and the ability to pick up, examine and modify objects within the virtual world. (c) The feeling of presence, or immersion, occurs as a consequence of realism of representation and high degree of user control.” (Dalgarno et al. 2002).

An online virtual world is a particular type of web VE where users can interact with each other. It is defined as “an electronic environment that visually mimics complex physical spaces, where people can interact with each other and with virtual objects, and where people are represented by animated characters” (Bainbridge 2007). The features of virtual worlds include shared space, graphical user interface, immediacy, interactivity, persistence, and community (Lesko & Hollingsworth, 2010; Penfold 2010).

Virtual Environments can be non-immersive (i.e. desktop VEs) or total immersion. Non-immersive virtual environments can be viewed on a PC with a standard monitor; interaction with the virtual world can occur by conventional means such as keyboards, mice, trackballs, and joysticks or may be enhanced by using 3D interaction devices such as a SpaceBall or DataGlove. Non-immersive VR has advantages in that it does not require special hardware; it can be delivered via web, and therefore can reach broad audiences. Immersive VR applications are usually presented on single or multiple screens, or through a stereoscopic head-mounted display unit. The user interacts with the 3D environment with specialized equipment such

as a data glove, a wand or a 3D mouse. Sensors on the head unit and/or data glove track the user’s movements/gestures and provide feedback that is used to revise the display, thus enabling smooth, real time interactivity.

In this chapter we focus on non-immersive VEs and we discuss learning benefits that have been explored with both single-user web VEs and multi-user, collaborative online virtual worlds.

VIRTUAL ENVIRONMENTS AND LEARNING

Discovery Learning

Discovery learning is defined as a “self-directed way of learning in which the planning and monitoring of the learning process are in the hands of the learner” (de Jong, 2005, p. 218). Virtual environments support discovery learning as they are motivating, active experiences controlled by the individual (Coffman & Klinger 2008). Immersion of students within a virtual environment can cultivate “learning by doing” as students use and apply their related prior experiences and further develop them by interacting with the environment (Land 2000). The discovery learning provided by virtual environments also supports the upcoming generation of “digital natives” (Prensky 2001, p.1) which think and learn in interactive, multimedia environments and need options for learning that are collaborative and creative (Loureiro & Bettencourt 2010). Learning is shifting from sets of knowledge transferred between teacher and students towards a more learner-centered approach focused on experience and exploration (De Freitas et al. 2009). Previously, a significant focus of education has been to teach the basics of literacy and mathematics, but now, with the advances of technology, it is becoming necessary to address 21st century workforce skills, such as digital literacy, which will ultimately impact productivity and creativity (Bavelier et al. 2010).

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