Chapter 2
Building an Instructional Design Model for Immersive Virtual Reality Learning Environments

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ABSTRACT

The recent increase in affordability of immersive virtual reality learning environments (IVRLEs) grows the interests of university, school, and industry training contexts. Due to their unique affordances, these environments have the potential to lead to a paradigm shift in learning experience design. The absence of learning design models, however, represents a significant challenge to the widespread and effective utilisation of this technology platform. Several researchers have proposed design models for virtual reality learning environments (VRLEs). The majority of these models don't explicitly consider the unique characteristics of Immersive environments. This research describes an instructional design model for IVRLEs, which draws upon Dalgarno and Lee's affordance model for VRLE and Tacgin's IVRLE development stages for teaching concepts and procedures. The specific learning strategies and affordances of IVRLEs are matched with the features of current IVR systems and technologies.

INTRODUCTION

The transformative potential of Virtual Reality (VR) technologies ensures that they continue to attract the attention of educational researchers. A growing number of educators in a wide range of fields seek to integrate VR technologies into their particular area. A substantial body of research supports the idea that the educational affordances of VR have the potential to enhance or potentially transform the learning experiences of students (Aebersold et al., 2018; Hu, Wu, & Shieh, 2016; Ke, Lee, & Xu, 2016). For the last five years, experience and visualisation based fields such as medicine, science, engineering,

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mechanics, architecture, etc. have made substantial breakthroughs in integrating VR technologies into their learning environments (LEs).

The power of VR comes from providing opportunities to represent both tangible and intangible phenomenon with a high level of visual realism. The highly realistic portrayal of the environment has a direct relationship to the sense of presence and the feeling of immersion experienced by the user. As a consequence, immersive VR has the potential to cover users' perceptions like a cocoon (Tacgin, 2018) in the context of a wide range of different scenarios.

This capability of VR attracts schools, universities, students, teachers, and learners within the industry and the professions. Although the use of VR technologies to their full capacity can be expensive, and many educational organisations are not able to meet the growing demand. To solve these deficiencies, web companies like Google, YouTube, Facebook, etc. have developed and promoted plug-ins to support the integration of 360° video or 3D VR technology into their products. One of the most affordable solutions, for example, is Google Cardboard, which allows exploring 3D environments after attaching a mobile phone to the cardboard goggles. After Cardboard, several companies have created mobile phone-based HMDs. This cheaper method offers increased access to VR technologies; however, the opportunities for environmental interaction has limits within these virtual environments (VEs). The most affordable interactive solution is using joystick controllers like those offered by Samsung Gear, VR Box, and Oculus Go. Additional devices like Leap Motion can also be used for supporting interaction, but the integration of these supplementary devices to HMDs might be cumbersome for some users.

Aside from access to appropriate hardware, another challenge is the availability of proper learning content. Designing 3D models and building 3D environments can be an onerous process because of the required time, skills of the multidisciplinary specialist, and high costs. The game engines producers have released plug-ins for novice users (e.g. Vuforia). There are also free 3D models and authoring tools (e.g. InstaVR) for the creation of 360° videos. Many teachers, lecturers and academics can now create their interactive 360° videos and share these contents with anyone who has stereo 3D goggles and mobile phones. The availability of laser scanners has provided a mechanism to scan a real environment to build virtual 3D models without having to master sophisticated 3D modelling tools.

The easy to use content creation tools provide enormous potential for rapid growth in the development of relevant content to a wide range of educational fields. As the degree of realism of the representation and mechanisms for interaction continue to grow, the likelihood of science fiction scenarios (e.g. those portrayed by the film Matrix) becomes ever closer as does the probability that VR will become an essential learning tool for educational organisations.

The results of studies do not reach a consensus regarding the benefits or restrictions of using IVR to teach. Some of the research suggests that the integration of innovative VR technologies into the education could reduce learning time, provide permanent knowledge, support experiential learning to increase psychomotor skills, support motivation, etc. (Hussein & Nätterdal, 2015; Mujber, Szecsi, & Hashmi, 2004; Plante, Cage, Clements, & Stover, 2006; Reinhart & Patron, 2003). The rapid advancement in technology along with the growing body of research evidence suggests that the affordances of VR could have enormous potential to reshape instructional methods and educational systems. According to some comparative studies, IVR does not provide measurable advantages to the learners and, traditional learning techniques might offer better outcomes.

The reality perception of IVR users is shifted by virtual components thereby they can move around, interact with the objects or characters in the IVRLE like in real life (Mast, Kleinlogel, Tur, Bachmann, 2018; Tacgin, 2020b). This authenticity regarding the 3D and spatial representation of virtuality is the