Chapter 9
Factors Affecting Primary School Students’ Learning Experiences When Using MUVEs: Development and Validation of a Scale

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ABSTRACT

3D multi-user virtual environments (MUVEs) are considered a technological advancement that, in the coming years, will have a significant impact on how students learn. On the other hand, the factors that shape the learning experience in such applications are not well studied. This chapter is an attempt to fill that gap. It reports the development and validation of a scale to measure the factors that come into play when primary school students use MUVEs in formal educational settings. Perceived learning effectiveness, perceived ease of use, presence, motivation, perceived application realism, interactions, enjoyment, as well as collaboration were used to develop a questionnaire that initially included 34 items. A total of 352 sixth-grade primary school students used a MUVE in formal educational settings and the aforementioned questionnaire was administered to them. The exploratory and confirmatory factor analysis revealed the existence of 7 factors and 24 items that were retained in the final version of the scale. The factor structure of the questionnaire is also discussed.

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INTRODUCTION

Information and communication technologies have significantly increased the level of independence students have when learning. They have also multiplied and diversified the ways in which students can learn and interact with the learning material. One technology that attracts the interest of educators and researchers is virtual reality (VR). VR is an “umbrella” term and various sub-genres do exist, one of which is 3D multi-user virtual environments (MUVEs). In recent years, there is a growing use of MUVEs in diverse educational settings (e.g., formal and informal learning) and in almost all learning domains (Merchant, Goetz, Cifuentes, Keeney-Kennicutt, & Davis, 2014). This calls for the use of instruments and methods assessing not only the learning outcomes they yield, but also assessing the interactions between a number of key factors that affect students’ learning experience when using them. By knowing how certain subjective constructs and MUVEs’ features interplay with each other, we can have an in-depth understanding of how MUVEs affect the learning outcomes. This, in turn, will allow us to develop strategies to maximize the impact of the positive elements and, at the same time, to minimize the impact of the negative ones, thus increasing the odds of achieving better results in terms of knowledge acquisition.

There are certain steps in this process, the first one being the development and validation of scales to measure the factors that come into play when students use MUVEs for educational purposes. The study presents the development of a scale to measure exactly this. A number of factors, namely perceived learning effectiveness, perceived ease of use, presence, motivation, perceived application’s realism, interactions, enjoyment, as well as collaboration, were included in the scale. The reasoning for selecting these factors, the research methodology, and the results of the exploratory and confirmatory factor analysis of the scale are discussed in the coming sections.

BACKGROUND

VR applications are 3D simulations of real or imaginary environments that “fool” the human senses; users have the feeling of being in a real environment (Hew & Cheung, 2010). Depending on the hardware and software used, VR can vary from fully immersive (that uses sophisticated equipment, such as head-mounted displays and haptic devices for the provision of somatosensory feedback), to simple “low-tech” desktop applications (that use just mid-range computers) (Levin, 2011). Furthermore, in MUVEs, multiple users can simultaneously use the same simulation; thus, they can interact not only with the virtual objects but also with each other. Principles drawn from constructivism provide the theoretical framework for the educational uses of MUVEs (Dickey, 2005). According to this theory, learning is an active process and knowledge is constructed on the basis of what learners already understand and as they make connections between new and old information (Ertmer & Newby, 2013). Social interaction, peer feedback, collaboration between users, visual and audio stimuli are but a few of their features that have an educational interest (Zheng & Newgarden, 2011). These, lead to, probably, the most significant benefits for education, that of incentives for learning and active learning (O’Neil, Wainess, & Baker, 2005).

There are numerous studies, in all levels of education, demonstrating the educational benefits when using VR/MUVEs. For example, in science education, the non-textually mediated presentation of the content, allows students to understand complex concepts (Squire, Barnett, Grant, & Higginbotham, 2004). Moreover, by encompassing both small and large scales, by allowing side-by-side comparisons, and by