Chapter 6
Immersive Virtual Reality as a Tool for Education: A Case Study

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ABSTRACT

After introducing the topic of education in immersive virtual reality (iVR), the authors describe the methodology and procedure used to test an educational game in virtual reality. The objective of this chapter is to contribute to the definition of a format for the evaluation of educational experiences in VR by describing the methodology adopted in the mentioned case study. A group of 30 students completed a lesson in virtual reality, and their experience was evaluated through qualitative (questionnaires, thinking aloud, interviews) and quantitative (task completion and time) tools. The results show some need for improvement of the simulation, but subjects were immersed in the experience and scored highly on the final assessment on understanding the educational content.

INTRODUCTION

The challenges posed by the Covid-19 health emergency have led the academic institutions to start an innovative process with the aim of using all the available digital technologies to support the quality of teaching, research, and student services (Baran, E., AlZoubi, D., 2020).

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In this perspective, attention has been given to immersive Virtual Reality (iVR) technologies. The Digital Agenda for Europe, one of the seven pillars of the European 2020 Strategy, states that VR is an innovative tool that, thanks to its multisensory and immersive nature, can satisfy the principles of active learning. Immersive virtual experiences foster, in fact, the sense of presence and embodiment, both key factors that can promote learning (Wiewiorra, L., Godlovitch, I., 2021). The use of immersive devices, with different types and different grades of involvement, is gaining growing interest for university education, in which students can no longer be considered recipients who acquire knowledge passively (Makransky, G et al. 2019). VR offers three main opportunities: it can change the abstract into the tangible, supports "doing" rather than just observing, can substitute methods that are desirable but practically infeasible even, if possible, in reality (Slater M., Sanchez-Vives M.V., 2016). In particular, many pivotal processes important in the teaching of Biology, Health Sciences, Medicine, Pharmacy, Biotechnology and Languages (Hein, R., et. al. 2001-2020) degree courses are difficult to visualize and iVR simulations can support students for a deeper understanding and easy learning of concepts.

The digital game environment has become an important tool for education and training, and evidence-based theories can be increasingly found on the educational benefits of interactive digital games related to the improvement of general cognitive skills (Johnson-Glenberg, M.C., 2018; Mayer, R. E., et.al., 2002) and motivation towards the content of learning (Roussou M, 2004; Checa, D., Bustillo A., 2019; Yildirim, B., et.al., 2020). When games are compared to conventional media, there are no results that indicate that they are generally inferior to traditional education (Mayer, R. E., et.al., 2002); especially when we look at case studies in the field of health and nutrition education (Ferguson B., 2012), we can argue that games can be as effective or more effective than traditional education for certain areas and learning objectives (Fox, J., Bailenson, J.N., 2009 ; Mayer, R. E., et.al., 2002).

This paper intends to contribute to the definition of a human-centered approach (Hassenzahl, M., 2010; IDEO, 2014; ISO, 2010) for the use of iVR experiences in teaching (Johnson-Glenberg, M.C., 2018) by describing a pilot conducted at the University of Siena at the LabVR UNISI with the collaboration of the Department of Molecular and Developmental Medicine of the University of Siena to measure the validity and usability of the educational game Oxistress (Collodel, G., et. al., 2019). The topic is male fertility; in men, infertility is related to poor seminal quality, often due to the presence of inflammatory states and an increase in free radicals (ROS) that damage sperm membranes. The ability to modulate the inflammatory process and ROS formation with dietary, non-pharmacological treatments could be a desirable goal for improving male reproductive efficiency.

Our main objective is an assessment of iVR to support learning outcomes in educational context (Di Natale et al., 2020). The basis of every immersive experience is the context in which the user's senses are effectively reached by the digitally reproduced artificial stimuli [Xie et al., 2021]. To date we are mainly talking about visual and auditory stimuli, but in the near future it will also be possible to provide feedback of a kinesthetic (or haptic) type. The environments or contexts that can be used for a lesson can be environments modeled in 3D or reproductions based on three-dimensional drawings produced by a technical artist, or a professional capable of modeling. The advantage of this approach is its extreme versatility, which allows you to reproduce at simplified resolutions and therefore with shorter times. It is also possible to reproduce environments acquired with 3D scans. 3D scanning and photogrammetry techniques today represent another way to obtain fast and high quality results. For example, in an archaeological site complex and irregular natural objects can be scanned with dedicated devices (3D scanner) or reconstructed from photographs (photogrammetry).