Chapter 3
Altered Realities:
How Virtual and Augmented Realities Are Supporting Learning

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ABSTRACT

As the use of both virtual reality (VR) and augmented reality (AR) become more commonplace in everyday life, the importance of including these technologies in schools increases. The focus of this chapter is to explore how these two technologies are being used at in primary, secondary, and tertiary contexts to support student learning. In exploring these technologies, science, technology, engineering, and maths (STEM)-related subjects, with a focus on Science, are examined. In investigating science, an investigation on informal learning is also undertaken. Non-STEM-related subjects including Physical Education, the Creative Arts, and Geography are also reported on. In investigating game-based learning Maths is examined where the concept of location-based learning is discussed. The chapter concludes by exploring how VR and AR can be used to support students with disabilities.

INTRODUCTION

Both virtual and augmented reality technologies have been available for some time and the demand for these two technologies is growing. According to a recent publication, the global augmented and virtual reality market is forecast to reach $94.4 billion by 2023. The increased demand for this stems mainly from the retail and e-commerce sectors (Cision PR Newswire, 2018). These technologies are also starting to have a greater impact in school classrooms in many countries due to increased sophistication and reduced costs. These technologies allow for experiences that would otherwise not be possible for students.

In considering virtual reality (VR), two types exist; low immersion (also referred to as desktop VR) and high immersion VR (generally involving a head-mounted display (Lee &Wong, 2014). “In desktop VR, the virtual reality environment (VRE) is displayed on a conventional PC monitor with sound com-

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ing through speakers and the interaction is controlled through a regular computer mouse" (Makransky, Terkildsen & Mayer, 2017, p. 2).

The technologies that currently support high-end immersion virtual reality include systems such as Oculus Rift and HTC Vive. These technologies require a powerful computer to run them which not all schools possess. Both of these systems have the headset tethered to the computer. Oculus Go has recently introduced a system which does not require the goggles to be tethered to a computer.

At the next level of sophistication, which does not require as much high end computer software, are the PlayStation and Samsung. The PlayStation is tethered whilst the Samsung is not, but it requires a Smartphone. At the bottom end is Google Cardboard, which also requires a Smartphone. Plastic headsets can also be purchased in which smart phones running VR apps can be inserted.

Azuma (1997) defines augmented reality (AR) as a system or visualization technique that has three characteristics: "1) Combines real and virtual 2) Interactive in real time 3) Registered in 3D" (p. 2). Augmented reality has been used in various media and systems for decades, e.g. head-up displays in fighter planes, scoreboards in sportscasts (Seppälä et al., 2016). It is now being used to support educational practices. In fact, it has been asserted that education is one of the most promising application areas for AR (Wu, Lee, Chang, & Liang, 2013). Augmented reality, using a device's camera to overlay information on the real world, can be experienced via a mobile device such as a smart phone or tablet, usually through an app. There are also headsets or glasses that can be worn that will overlay this information. AR allows virtual information to be superimposed onto physical objects and environments. AR can either superimpose real-world objects into a virtual environment or bring virtual objects into reality (Milgram & Kishino, 1994). Additionally, research evidence suggests that AR can increase student motivation in the learning process (Bujak et al., 2013).

The popularity of Pokémon Go successfully introduced AR to a broader audience (Wingfield & Isaac, 2016) demonstrating how it can be used for entertainment purposes. There are many important ways it, and other AR apps can also support educational outcomes, some of which are explored in this chapter.

The area of Science, Technology, Engineering and Maths (STEM) education is now a major focus of politicians and economists who recognise that professionals will be needed for innovation and economics globally (Eisenhart, Weis, Allen, Cipollone & Stich, 2015). In response to this recognition, many school systems are now turning to both virtual and augmented reality to support learning in this area. A focus of the chapter will be to explore how VR and AR are being used to support STEM-based learning with a focus on Science and will also examine how AR is being used to support informal learning. Non-STEM subjects including, Physical Education, the Creative Arts and Geography, are also explored.

The use of games and gamification in AR and VR to support learning is an area that is increasing in schools. Games offer the potential to connect abstract scientific concepts to everyday experiences (Laine, Nygren, Dirin & Suk, 2016). This can be done by situating learning processes in real-world contexts, and by bridging the virtual content and the real world with augmented and virtual reality. Some of the different types of games used in an AR environment related to Maths and with a focus on location-based learning are investigated in this chapter.

Another area that is outlined in this chapter is the use of VR/AR to support students with disabilities. There are a wide range of disabilities, both physical and cognitive, that impact on school age students. The use of VR and AR provides opportunities for students to engage with meaningful learning using tools ranging from fully immersive systems to smart glasses. It has been demonstrated that the use of VR and AR can have a positive effect on learning outcomes for students with disabilities (Lorenzo, Lledó, Pomares & Roig, 2016). This chapter explores the types of VR/AR experiences available to support