Chapter 1.23
Virtual Reality and Immersive Technology in Education

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ABSTRACT

Virtual reality, also known as VR, is an exciting but ill-defined field of discovery. The question of how technological advances in this field will impact education is difficult to answer at present with any degree of certainty, but is one that must be considered by educational researchers, teachers, and administrators. This position paper presents the foundational definitions and positions of several investigators in this realm, along with thoughts on difficulties and complex issues that currently hinder the application of virtual reality in educational settings. It is recommended that the excitement that VR generates be leveraged into applications research in order to validate both the effectiveness of VR in education and encourage further development of the technology.

INTRODUCTION

Virtual reality (VR) is a phrase that is frequently used in discussions of technological advancements in the science, computer, and entertainment fields, among others. However, VR is a very broad and multifaceted term that means different things depending on its source and application. Furthermore, is it a technology that has value for the fields of education and training? In this article, the author will attempt to define one aspect of virtual reality and gauge its potential for the instructional environment.

CONCEPTUAL FRAMEWORK

As might be expected, the definition of what virtual reality is differs from field to field depending on focus and usage. Generally VR can be defined as the use of computers and related technology to produce an artificial environment that simulates a targeted one. Senovsky and Kodym (1999) state that VR depends on the design and manipulation of 3D models, and may or may not require the use of other peripheral devices to simulate sensory input. They further claim that there are four key components to a VR program: (1) all events must happen in real time, (2) the artificial environment must be three dimensional, (3) the user is able to enter into the environment and move in it freely, and (4) the environment is not static but can be manipulated by the user. Several authors (Javidi, 1999; Macedonia & Rosenbloom, 2000; Taxén & Naeve, 2001) emphasize that VR must place the user inside the artificial environment to be truly considered as virtual reality. This capability, known as immersive virtual reality, provides the opportunity for full sensory simulation. Billinghurst (2002) uses a continuum of reality to differentiate "augmented" reality (partial immersion) from total immersion based on the amount of the user's world that is produced by computer. These differences in definition have generated some confusion regarding the actual nature of VR and its application in education. This article will focus on immersive VR and its potential in future educational settings.

There is little question that this technology will be critical in future learning environments. Jacobs and Dempsey (2002) claim that the high level goals of education in the future will only be able to be accomplished through the use of artificial intelligence in virtual settings. Taxén and Naeve (2001) point out the significant advantages that VR offers by placing students in discovery and experiential environments that would be impossible in real life. They note that applications have been developed for teaching in the areas of science, math, art, and history, although not always in the fully immersive environment. Interestingly, they predict that too much reality in immersive settings may actually be distracting to students and prevent focus on the desired learning objective. De Moraes, Machado, Gnecco, and Cabral (2002) show an effective use of "Cave" immersive environments in the teaching of statistical interpretation and data analysis. Javidi (1999) suggests that immersive learning is very constructivist and that the level of discovery and experiential learning that the technology provides will drive education more in that philosophical direction in the future.

The important role that immersive VR will play in the future of education in many technical areas cannot be understated. Beier (2004) points out that any three-dimensional environment can be simulated in VR, including such a variety as "buildings, landscapes, underwater shipwrecks, spacecrafts, archaeological excavation sites, human anatomy, sculptures, crime scene reconstructions, solar systems, and so on." Pantelidis (2000) describes situations when using VR technologies would be beneficial to educators. She explains that any teaching or training experience in an actual environment that is too dangerous, difficult, inconvenient, expensive, or impossible is a prime candidate for virtual reality scenarios. Kalawsky (1998) states that VR capabilities will aid the educator in simulating complex systems, magnification or reduction of environments, and accelerating or decelerating time passage. Current examples of such educational applications in VR include: architectural design (Donath & Regenbrecht, 1999), ergonomic design (Cerney, Duncan & Vance, 2002), molecular nanotechnology (Stevens & Judson, 2004), and oceanographic and meteorological studies (Moore, 2002). Finally, Kalawsky (1998) lists many potential educational areas for VR application, such as: civil engineering, aerospace engineering, architecture, automotive engineering, chemistry, design, finance, geographical information systems (GIS), historical scenarios, manufacturing, medical, and sports science. Clearly the future use of immersive VR in educational and training settings will only be