

PERSPECTIVES ON TEACHING

The Potential and Uniqueness of Virtual Environments for Education

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Virtual environments (VEs) are growing in popularity among educators and have unique potential for online learning. This paper describes the unique characteristics of VEs that make them an effective venue for online learning due to increased environmental presence. Unique characteristics of VEs include nature of visual stimuli, control of the environment, amount and variety of sensory information utilized by the learner, and level of immersion by the learner. Examples of learning opportunities in VEs are explored. Current disadvantages are also discussed.

Popularity and Demand of Online Learning

Online learning has increased in popularity in the past several years, and the trend seems likely to continue. A five-year study conducted by the Sloan Consortium (2007) found that from 2002-2007 the number of college students taking at least one online course doubled. Companies have found online learning to be a cost effective way to deliver employee training. Draves (2002) states that online learning will account for 50% of all learning by 2050. Although demand for online learning seems to be increasing, attrition rates for online classes are 10 - 20% higher than their face-to-face counterparts (Angelino, Williams, & Natvig, 2007). The unique characteristics of virtual environments (VEs) may have the potential to increase engagement and decrease online attrition. VEs are immersive, 3D computer-generated environments where people are represented by avatars that move through the environment much like the physical environment. Multiple people can be in the same virtual space and react with one another simultaneously in real time. VEs can add a level of realism to role plays and simulations that has not previously been possible in an online learning environment.

This paper seeks to identify the unique characteristics of VEs that make them a good choice for online education, highlight potential educational applications using a VE, and discuss current disadvantages and barriers to VEs. *The Horizon Report* (New Media Consortium & Educause Learning Initiative, 2007), a research-oriented effort, attempts to identify emerging technologies that will have a significant impact on education. It contends that by 2010 VEs will have widespread adoption for teaching and learning on university campuses. Currently there are already over 120 universities that have a presence in a VE, including Harvard Law, Bradley University, Rice, The University of California, Berkley, the Rochester Institute of Technology, Seton Hall, and Ohio University. In one popular virtual environment, Second Life (Linden Lab, 2003), there are over 80 groups dedicated to educators and a listserv devoted to educators with

over 4700 subscribers. Several corporations also have a presence in Second Life, including IBM, Reuters, BMW, Cisco, HP, and Adidas.

A Comparison

Let's consider the evolution of the internet over the past several years. Static text-based pages were the norm 15 years ago. Currently Web 2.0, the second generation of the internet characterized by web-based communities, social networking, collaboration, and sharing among users, is becoming a dominant presence. In the same way, in its infancy much of online learning could be classified as electronic page turners where the learner read text on the screen and clicked a button to advance to the next screen. The learning might have included a graphic or a photo to help illustrate a point. As internet connection speeds increased and more people had access to faster connections, audio, video, and animations were added to the online learning format.

It is common today for online learning to be delivered using learning management systems (LMSs) such as Blackboard or WebCT to house their online courses. Some popular LMSs are merely used as repositories for documents, grades, and assignments, with interaction taking place in discussion boards or chat sessions. These types of online learning systems lack a sense of immediacy, which limits interaction. Some companies use software for training that shows a real-time presentation with live audio, allowing participants to ask chat questions or virtually raise their hand. Although the sense of immediacy is increased with these types of collaborative softwares, VEs add a sense of simultaneous personal interaction and visual stimuli missing from mainstream online learning. Just as the internet has advanced from static pages to interactive social communities, online learning may advance from static information repositories with limited interaction to immersive, highly visual, social environments that more closely emulate the world we live in. VEs, with their potential to draw in the learner and create an interesting and immersive learning environment, could have a considerable impact on the future of online learning.

A Unique Environment

Let's consider some of the unique properties that VEs bring to online learning. In traditional online learning environments, information is merely transmitted from a sender to a receiver (student-to-student or student-to-teacher). In a VE, the learner is both a sender and receiver and reacts with the environment. The environment is created and then experienced by the learner (Steuer, 1992). One of the most important characteristics of VEs is the notion of presence. Presence is defined as the sense of "being there" in the environment (Bystrom, Barfield, & Hendrix, 1999; Steuer, 1992; Witmer & Singer, 1998). Although there has been considerable discussion related to presence and VEs, there has been little empirical research. Heeter (1992) describes three types of presence: (a) social, (b) personal, and (c) environmental. In this paper, I focus on several characteristics in a VE that increase the sense of environmental presence, which could increase its effectiveness for use in online education.

Visual Channels

Visual channels strongly influence presence (Witmer & Singer, 1998). The 3D visual component of VEs adds a sense of realism to the online learning experience. One study showed that relevant visual stimuli enhanced task performance in a desktop virtual environment setting (Mania & Chalmers, 2001). VEs allow considerable flexibility for the participant to control his or her view within the environment. Normally the participant views the environment from a few yards behind one's avatar (the 3D graphical representation of oneself). The avatar looks where the mouse is pointed. As the participant moves the mouse, the avatar's head moves and tracks with the mouse as if it were looking around. The participant also has the option of viewing the environment from the "eyes" of the avatar, creating a greater sense of realism. The participant can circle around objects and move past them in 3D space similar to real life. This adds realism to the experience, enhancing the sense of environmental presence. It also increases the sense of visual immersion, which is the defining quality for VEs (Whitton, 2003).

Environmental Control

Environmental presence is also enhanced by the user's ability to control and interact with the environment (Steuer, 1992). In a VE, the participant has the ability to modify the environment in real time. One can manipulate and build objects and change the appearance and size of any created object. Objects can be made to scale using a numeric grid, and physical characteristics, such as gravity, can be added to objects the learner creates. These types of environmental controls have traditionally not been possible in mainstream online courses. Participants can also add programming to objects that enable certain functions to be performed when acted upon. For example, it is possible for avatars to "touch" or click on an object making a detailed description appear written by the trainer or teacher. Or, avatars could touch a pair of dice to make them roll to decide who will go first in an exercise.

Advanced camera controls allow participants to move around the environment without moving their avatar. Using the camera, participants can look around corners, through walls, and view the environment from overhead or several meters in front or behind their avatar while the avatar remains stationary.

Variety of Sensory Input

The variety and complexity of sensory factors stimulated in the environment also enhance environmental presence (Steuer, 1992; Whitton, 2003). Consider your sense of being in the real physical environment. You are sitting on your front porch at sunset. You feel a sense of "being there" because several of your senses are involved in the experience and send you sensory information that is meaningful to you. You see the sunset, the changes in the color of the sky, people walking by on the street, you hear a dog bark, you smell the flowers in the nearby garden, and you feel the breeze on your face. If you begin reading a book, however, you may get so involved in the story that your sense of presence may switch from your physical environment to the environment created in the story. In other words, you will be less aware of your physical environment and more immersed in the environment created in the book. Creators of movies and theme park rides have developed greater sensory experiences to allow patrons to feel more

immersed in the experience. Surround sound has been added to movie theaters to increase the depth of sound. Movement has been added to theme park rides, such as vibrating seats and other haptic sensations, such as squirting water, which enhance realism. VEs' ability to add sensory information to a learning experience adds realism and increases the sense of actually being in the environment.

Many online learning solutions utilize a self-running asynchronous program, or possibly an LMS, to deliver information to the learner. Usually this information is text based. Non verbal behaviors are communicated via emoticons, that is, keyboard symbols used to convey emotions. Although video and audio can be incorporated, it is normally in a passive format. Synchronous programs can add some limited interaction, such as live chat, or real-time interaction with the use of collaborative software such as Elluminate *LIVE!* (Elluminate, Inc.) or IBM Lotus Sametime (IBM, Inc). By comparison, VEs add multiple and various sensory stimuli simultaneously, more like a real life experience. For example, discussion boards and live chat sessions are text based but do not include other sensory stimuli. Video and TV include sight and sound but have little interaction. Collaborative software allows all learners to be together in the online classroom, but normally they can only interact through text or audio. VEs include sight, sound, movement, and real-time interaction among all participants simultaneously in a 3D environment. Seeing the other avatars allows visual feedback between participants, which enhances interaction. Non-verbal behaviors can be displayed by avatars, similar to viewing non-verbal behaviors in the real world. The environment simulates sunset, sunrise, and environmental sounds, such as birds singing or the waves crashing against the shore--much like real life. Involving additional sensory stimuli makes it possible to create an enhanced feeling of presence in the environment (Witmer & Singer, 1998). Although movement in a desktop VE is normally generated by input from a keyboard or mouse, with the invention of the Nintendo® Wii™ (Nintendo, 2006) video game it may not be long before movement in a VE is controlled by a similar remote device, utilizing actual body movement to move and act in the environment.

Degree of Attention and Immersion

Another factor contributing to the sense of presence in a VE is the level of attention of the participant or sense of immersion in the environment. Immersion is characterized by the participant's feeling included in, and interacting with, an environment that provides a continuous stream of stimuli. A greater degree of immersion produces a greater sense of presence (Witmer & Singer, 1998). Immersion is affected by how natural the movement and controls in the environment feel to the participant. If movement and interaction within the environment feel natural, this enhances the feeling of immersion. The more the controls and interaction feel awkward (such as wearing a 3D head mount display during a virtual reality simulation), the less the participant feels immersed in the environment (Witmer & Singer, 1998). One study (Mania & Chalmers, 2001) found participants' sense of losing track of time was higher in a desktop virtual environment than in a real environment or an audio-only condition.

Examples and Uses of VEs in Education

The uniqueness of the VE allows for educational possibilities that are difficult and sometimes impossible to achieve in real life. There are several ways VEs can be used effectively

in training and education. Medical health education is one way VEs are being used. In a VE, learners can explore reproductions of things too small to see with the naked eye, such as a human cell. They can use their avatars to move around inside the cell, enabling them to see its components and structure up close while watching an animation of how it works. VEs are also being used to treat phobias. Participants can experience a fearful place in a safe way and practice coping skills without risk before trying these skills in real life. At one medical health clinic in Second Life, role plays are being conducted by learners who assume the role of doctor, nurse, patient, or patient's spouse for training and educational purposes (Childress & Braswell, 2006). A hallucination lab in Second Life, developed by UC Davis and based on actual patient experiences, is being used in the school's medical school program and as an educational tool for caregivers attending an early intervention program. Qualitative survey results show that 73% of respondents believe the lab improved their understanding of hallucinations (Yellowlees & Cook, 2006).

Learners can examine issues related to diversity in a VE, as their avatars can literally be anything they choose. There are no physical limitations or disabilities in a VE. Avatars can be short, tall, fat, thin, male, female, African American, Caucasian, Asian, have a disability (or not), or even be an animal. Participants have complete control over how their avatar appears and can change their appearance instantly. This has the potential for learners to experience the VE as a different race, ethnicity, gender, size, or shape.

Simulations of almost any real-life scenario are possible in VEs. Participants can practice running a virtual business or conducting a home inspection. A natural disaster, environmental hazard, or terrorist attack can be simulated in the environment in which participants have a chance to practice proper skills and procedures. Law enforcement and medical personnel can practice how to react in these situations in real time. Simulations of this type that are virtually impossible in real life can now be easily conducted with considerable realism in a VE.

Architectural applications could be utilized with considerably less time and expense in VEs than in real life. Architects can use VEs to build and test prototypes in a 3D model that utilize real physical properties, such as gravity, with much less expense than in real life.

Role plays are also an effective use of VEs. Participants can role play a sales call or employee performance review, or develop conflict resolution skills in an online environment with other avatars. The VE creates a realistic yet safe environment to conduct trials with little risk. Non verbal behaviors by the avatars can enhance and add a new level of realism to the role plays not previously possible in an online learning environment.

Disadvantages

The biggest disadvantages of VEs include the learning curve to become proficient in the environment and the need for high end hardware. To become fully functional in a VE requires approximately 20 hours according to some estimates. If a trainer or instructor wants to construct a learning environment within a virtual environment, he or she will be required to commit the time necessary to learn how to do so or commit to additional staff or resources to construct the environment for him or her.

Since the technology requirements needed to run the VE software can be advanced, many older computers and slower internet connections may have difficulty using the environment effectively. This could be a barrier for learners who are off-site or companies that have older technology. If all learners do not have access to the technology required to use the VE, trainers may be required to provide optional activities, creating additional development and assessment time. Trainers and HR departments must examine student access to the technology when considering a VE for learning delivery.

Similar to the advent of the internet, the majority of the general public did not initially have the hardware and connection speed for everyday use. Over time however, ease of use and availability of the technology became more prevalent. The same may be true of VEs. Although technology requirements may be out of reach for some now, it may be widely accessible for a large majority of learners in 5-10 years.

Summary

The unique characteristics of a VE produce a more visually stimulating, immersive environment that enhances the sense of environmental presence in online learning. This could result in learners becoming more engaged than with traditional online learning delivery methods. If the environment is used effectively and current disadvantages overcome, VEs may have widespread implications for online learning in upcoming years.

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