Virtual Reality Learning
Effects in College and Training Environments

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Abstract

The paper explains how research was conducted on desktop virtual reality (VR) in a four-year college, technical college, and industry training environments. It describes what the research team discovered to be important factors in its successful implementation of virtual reality in all three environments. The initial research project was conducted with a college and the Occupational Education Virtual Reality Research Team at Oklahoma State University with the purpose of determining the learning effects of desktop virtual reality (VR) in college and technical training. Participants in the initial study were students from a college and a career tech center surgical technician programs.

The second phase of the research was based on virtual reality as it was applied at a training center for a local industry in the Fort Smith, Arkansas area. The results from the initial research were applied as animation students developed training DVDs for industry employees. The learning effects of the industry trainees were compared to the results of the students from the classroom setting of the original research project.

The research revealed no differences in the college setting as compared to the industry training environment. Additional research is being conducted in a totally different classroom setting using virtual reality to teach welding. Results from this environment will be compared at a later date with the original and the second phase virtual reality findings.

Introduction

Virtual reality (VR) technologies are creating stunning shifts in the ways people communicate, work, and interact with each other, with information, and with technology interfaces. According to Davies (2004), VR is a “… technique of using computers to model real (or imaginary) environments in a three dimensional space that allows people to interact with the environment in a fashion that is both natural and intuitive” (p. 3). Loftin, Chen, and Rosenblum (2005) defined VR as “… technologies that provide multimodal display of and interaction with information in real time, enabling a user or users to occupy, navigate, and manipulate a computer-generated environment” (p. 749). Ausburn and Ausburn (2008a, 2008b) reported that VR can
currently refer to a variety of computer-based experiences ranging from fully-immersive via complex head gear and body suits, to realistic PC-based imagery. According to the Ausburns (2008a, 2008b), all types of VR simulate or replicate a 3D environment and give users a powerful sense of “being there,” taking control, and actively interacting with a space and its contents. These virtual environments (VEs) can immerse users/learners in a bounded graphical space and give them a strong feeling that they have actually been somewhere rather than just viewing it (Di Blas & Poggi, 2007; Mikropoulos, 2006).

In the original research conducted by the Occupational Education Virtual Reality Research Team at Oklahoma State University (OSU), VR technologies were used to occupy, navigate, manipulate, and control realistic computer-generated surgery environments. The studies combined theory-based quasi-experiments consisting of qualitative interviews with learners exposed to desktop VEs for surgical operating rooms (Ausburn and Ausburn, 2010). Specifically, the research conducted by the team compared the learning effects of two different types of desktop virtual reality (VR) in presenting scenes and equipment in surgical operating rooms. This technology was used in a way that supports the instruction, where adult learners can use technology to obtain information and meet their learning needs.

The results obtained from this study were then applied to the creation of a VR environment to be used in industry training. Researchers have found that the use of technology for adult literacy and education has grown with the use of the Internet and animated graphics. In the follow-up study, animators used VR applications that aided in the development of training DVDs used for a local industry. The training results were compared back to the results of the original surgery classroom study.

**Review of Related Literature**

This literature review builds upon research on the integration of Virtual Reality (VR) and three-dimensional (3D) computer modeling on learning and teaching. The review discusses the values and challenges of integrating visualization technologies into the teaching environment and investigates perceptions, opinions, and concerns with respect to these technologies.

Students are entering higher education increasingly computer-literate, with high expectations that they will be introduced to appropriate technologies for their subject disciplines. Academic schools are challenged by these new technologies and require appropriate strategies for their effective integration and adoption. These strategies need to be given greater awareness and understanding of innovation within the academic curriculum (Knight, 2006).

In the mid-1960s, Ivan Sutherland’s thesis, “Sketchpad: A Man-machine Graphical Communications System,” was introduced as a highly precise computerized drawing system. With Sutherland’s computerized drawing system, this graphical tool made today’s computer-aided
drafting (CAD) systems possible. Since that time, the impact of computers in education has resulted in much research and application (Bridges, 1986). The initial inclusion of computer-related subjects as stand-alone modules in the structure of academic programs can offer a way for students and staff to become familiar and confident with computer applications, which would result in further appropriate integration into other subject areas (Hamza & Horne, 2006).

Since many tasks in our everyday lives depend on our ability to recognize the three-dimensionality of the environment around us, from conceptual design to the final product itself, it is important to be able to appreciate the built environment in this manner as well (Dalgarno, Heldberg & Harper, 2002). 3D modeling and especially VR are beginning to be used extensive in built environment education. 3D virtual environments can provide a rich, interactive, and engaging educational context that supports experimental learning (Mantovani, 2003).

R. Ellis explains that information technology has the potential to enhance the quality of the educational experience for all students, and ongoing work on the development of a virtual construction site project has received favorable reactions from those students introduced to new technologies (Ellis, 2006). As D. Bouchlaghem (2005) explains, “the process of design and visualization should be iterative, with changes made as a result of insights gained through visualization propagated into the next version of the design,” and this “collaborative building design requires a shared understanding to be reached between all parties involved”.

With 3D, 4D, and VR visualizations, “students can experiment with different ‘what-if’ scenarios and actively discover unique solutions to construction planning challenges” (Messner & Horman, 2003). Researcher F. Mantovani indicates “the point is no more to establish whether VR is useful or not for education; the focus is instead on understanding how to design and use VR to support the learning process” (Mantovani, 2003). With selected desktop VR and semi-immersive VR technologies as appropriate types of VR to be used by students, the approach of developing links with software companies and built environment professional practices offers real-world case studies and applications of VR that illustrates how VR technology can be applied.

Technology has the ability to assist in the teaching process, enabling students to view and interact with the concepts they are working in 3D immersive environments as shown below in Figure 1(Ausburn & Ausburn, 2004). The user employs a mouse to move and explore within an on-screen virtual environment as if actually moving within a place in the real world. Movements can include rotating the panoramic image to simulate physical movements of the body and head, and zooming in and out to simulate movements toward and away from objects or parts of the scene. Embedded individual virtual objects can be “picked up,” rotated, and examined as the user chooses, and clickable “hot spots” can also be used to navigate at will (Ausburn, 2010).
Three factors appear to be critical to successful VE implementation: the ability to teach VR users to understand that a VE is a complete “world” to be carefully and systematically explored, a clear explanation of the learning purpose and tasks before entering the VE “world,” and adequate training and practice time in manipulating and navigating a VR program before immersion and interaction with a learning task. (Ausburn, 2010).

**Administering the Research Test**

For the initial research, the VR group from OSU went to a hospital’s operating room to create the images for the VR scenes. The desktop operating room VR “movies” were created by taking a series of digital still photographic images and then using special VR software (VR WORKS, PANO WEAVER, TOUR WEAVER) to “stitch and blend” the images into a single panoramic scene that the user can “enter” and explore individually and interactively. The user would employ a mouse to move and explore within an on-screen virtual environment as if he or she were actually moving within a space in the real world. Movements could include rotating the panoramic image to simulate physical movements of the body and head, and zooming in and out to simulate movements toward and away from objects or parts of the scene. Embedded individual virtual objects can be “picked up,” rotated, and examined as the user chooses, and clickable “hot spots” can also be used to navigate at will (Ausburn, 2010).
Each subject was given a demographic survey to complete and a copy of the SPT1 answer sheet, which is a level of visualizing skill assessment using the Successive Perception Test 1 (SPT1), which is a video-based test that requires subjects to recall and select the screen picture.

The Successive Perception Test1 (SPT1) instrument was used to measure Lowenfeld's visual/haptic typology. Lowenfeld discovered that individuals with visual learning abilities had a higher chance of discriminating details that were visual. Furthermore, their reaction was also noted to be more impersonal. On the other hand, haptic learners (those with learning abilities based in the sense of touch) were not in a position to discriminate details that were visual and had a higher chance of reacting to situations with more emotions. Lowenfeld revealed that a number of individuals that were partially blind had the ability to make use of the little sight that they possessed to either view an object or apply their other senses as a way of expressing themselves. However, other individuals that were also partially blind were not in a position to utilize their eyes. These individuals found it more useful to apply touch senses (Lowenfeld, 1970).

The participant was then trained on how to operate the type of VR treatment he/she would be using during the activity. Each subject was assigned to either navigated or non-navigated VR treatments, so the VR group only needed to train each subject on how to operate one kind of presentation. It was explained to the subject that the researcher would show him/her a computer presentation that would demonstrate how to work the VR program.

The second research subjects were local industry labors being trained on OSHA safety features applied to heavy steel manufacturing. The same tests were used on the labors. The differences between the two set of data collected pertained to the VR settings. The first research was conducted in a VR surgery room and the second in a VR steel manufacturing environment.

Results and Analysis of Data

According to the posted results from the OSU VR research team (Steele, 2010), the second group of researchers also found the same results with minor differences. The results were guided by predictive research hypotheses situated in a collection of theoretical bases and supporting empirical research literature. According to Debra Steel (2011), these have included the following:

LOWENFELD'S VISUAL/HAPTIC TYPOLOGY: Lowenfeld and Brittain describe haptic and visual styles of learning as being on opposite ends of the continuum. It has been noted that a majority of people usually fall between the two extremes. Persons that are visually oriented are not able to adapt to a given situation via means of kinesthetic and touch functions with ease. Lowenfeld has noted that as individuals advance in age, their haptic and visual perception also tends to diminish in importance (Lowenfeld, & Brittain, 1987).

This may be regarded as more of a developmental effect as an increasing number of individuals turns more visual as they advance in age. Compared with other forms of perceptual styles, haptic perceptual style has a lot more significance amongst adults. Lowenfeld and Brittan state “that for some children, not only those who might be termed
extreme haptics, school may be frustrating because of the emphasis on visual learning.”

Lowenfeld and Brittain go on to say, “the person with haptic tendencies, on the other hand, is concerned primarily with body sensations and subjective experiences, which are felt emotionally” importance (Lowenfeld, & Brittain, 1987).

AGE AND TECHNOLOGY: Well-known research on age and generational differences in technology experience and self-efficacy (e.g., Howe & Strauss, 2000, 2003; Prensky, 2001; Tapscott, 1998) has presented evidence that these differences may relate to perceptions and performance with technology-based learning (Ausburn & Ausburn, 2010). A recent study of older adult computer users suggests there is a gender difference in anxiety levels in older adult computer users, with women displaying more anxiety and reporting less computer knowledge, despite the fact that males and females reported similar levels of computer usage (Hopey, 1999).

AGE, COMPUTER SKILLS, AND PRIOR GAMING EXPERIENCE: While these variables were included, the VR studies at the university found one of the limitations of the study may be the small sample size and limited range of these variables. These findings indicated that in the study between the college and OSU there were no differences in age and technology, and what was found were deficiencies in learner preparation and training for VR (Ausburn, 2010).

The results from the industry subjects were slightly different in the last area. The sample size was larger due to the extended use of the training DVDs. Four different industry locations used the DVDs making the sample size (N=134) reliable. The UA Fort Smith animation team developed the safety training DVDs based on information gained from the VRs developed by the OSU VR research team. The safety videos were created using raw animation incorporated in a gaming environment, giving the industry subjects a more realistic VR environment. The game simulator allowed the movement to be very smooth and easy to manipulate. As can be seen in Figure 2 and 3, the environments were very realistic.

![Main Work Floor](image-url)

Figure 2. Main Work Floor
Conclusions

From both sets of data, the main question to be answered was whether age affects the levels of technophobia. There were no differences in the use of technology between the different age levels or genders observed at the two schools and the local industry. What was found were deficiencies in learner preparation and training for virtual reality environments. The realistic environment made a big difference in the ease of use.

Additional research is being conducted in a totally different environment. The setting will be a VR for welding. The planned research will start with a basic welding environment and then expand out to under water VR environments. The results will be compared with the original findings from the OSU research team and the industry research team.

References


