VIRTUAL REALITY AND LEARNING: TRENDS AND ISSUES

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ABSTRACT

During the last years we have started to see diverse views in relation to the use of Virtual Reality to enhance learning and cognition. Authors disagree in their opinions about the real value of VR interfaces. VR has rapidly emerged as a very promising technology that will probably match the innovation of technologies such as multimedia/hypermedia.

This study stems from our research work and intends to discuss about the VR technology available today and the impact it may have on education. We analyze the major trends in the use of Virtual Reality for learning purposes. We intend to match what the theory says about the possible effects of virtual reality with the actual preliminary results communicated in the specialized literature. In addition, as a result of the trend analysis we shed some light about the major issues highlighted in some experiences of using VR to assist learning and cognition.

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1. INTRODUCTION

Virtual Reality (VR) is a computer-based technology that provides visual, aural and tactile stimuli of a virtual world generated in real time. This is usually achieved by isolating the user from the sensorial signals of the real world, thus creating the immersion effect. The VR technology came up from forty years of development in areas such as computer science, electronics and psychology. From the beginning, VR has been used for simulation and training, mainly in the military arena. Therefore, the use of this technology was justified not because of its added value as an educational tool but mainly because military VR simulators allow to test different situations without putting extremely expensive material and personnel in high risk situations. Due to cost reasons, the use of VR technology was associated in the beginning to scientific military visualization, and entertainment. Other applications were only made possible with the decrease in equipment costs in the past few years. One of these newer areas of VR applications is education, centered mainly on the merging of education with entertainment, supporting the birthday to a new field "edutainment".

2. VIRTUAL WORLDS CHARACTERIZATION

A virtual environment can be analyzed as consisting of a computer, a human-computer interface and one or more users that perceive and interact with a virtual world. The computer and the pertinent input and output devices is configured to create the sensation of immersing the user in a synthetic environment containing three-dimensional (3D) objects with spatially determined positions and orientations, and usually a behavior or autonomous activity. A virtual world can reflect real world characteristics in several ways, somehow abstract, depending on the type of application in question.

The main objective of VR is to give the user a synthetic experience that intends to transfer physical and abstract concepts of a given environment. When using VR systems the user is involved in a new interactive environment which is made available by artificial electronic and electromechanical devices. Therefore, the efficiency of the subjective sensation of presence depends on the human-computer interface and the fidelity of the virtual interactions made available.

One of the current lines of research aims to increment of the sensation of *presence* in the virtual world thus diminishing the influence of the real world in the synthetic experience. This characteristic is usually referred to as *virtual presence* and depends on several factors such as the level of transparency of the interface presented to the user and the isolation of the stimuli from the real world as well as the quantity and quality of the type of interaction existing in the virtual world.

The difference between virtual environments and other types of computer systems, like desktop based environments, relies on the level of interaction, the diversity of sensorial modes and the immersivity.

3. VIRTUAL REALITY AND EDUCATION

Immersion in VR is achieved with the disappearance of an artificial interface, replaced by natural everyday's actions present in the real world. This is one of the key aspects of VR that brings together many researchers to support it. Some other advantages of immersion are not so obvious, but very important for justifying the use of VR in education, such as:

- VR enables first person experiences, which are natural, unreflected and personal, generating direct, subjective and personal knowledge.
- VR provides a less symbolic interaction with the environment. Any description of an experience or action is usually transmitted through of symbols, conventions and formalisms, meaning that traditional learning of a concept requires previous knowledge of symbology.

For this reason, the use of immersive systems enables interaction using "real world language" [Bricken 91], giving the opportunity of experiencing before handling formalisms.

Constructivism [Jonassen 96], describes how first person experiences and knowledge are constructed and stands for the idea that the imposing of symbolic representations to enable communication requires previous meaning negotiation leading to a compromise. VR experiences designed for a single user fit perfectly in this theory, fundamenting a theory for learning in virtual environments, because the overhead of symbolic formalism is diminished. Immersion in a virtual world permits users to experience the same kind of interaction with objects as in the real world. If knowledge in non-symbolic and learning is closely related to the action then interaction with the virtual world can contribute to the construction of knowledge.

Constructionism, a branch of constructivism, proposes the idea that knowledge is constructed through the physical interaction with the real world. Physical and perceptual interactions in first person are covered by VR. Because of VR can simulate a real world users may learn while placed in the context where they should apply that learning. This enables two types of experiences of construction of knowledge not available in the real world, which have a high potential in education: Scale and Transduction [Winn 93]. Scale is the process of distorting the relative dimensions of objects and the virtual world to give access to new perspectives. Transduction is the conversion of usually unperceptible data into information that is perceptible to human senses. Therefore it is possible to say that VR is a powerful technology susceptible to be used for knowledge construction under the umbrella of both constructivism and constructionism.

Even though we have some interesting theoretical view of possible associations between VR capabilities and constructivist learning, experiences with VR in educational settings do not give clear picture and generalizable results. As a result, there is a controversy about the real effects of VR on learning and cognition. Preliminary results indicate that the usage of VR can:

- improve learning performance: some documented experiences note that there is a significant increase in users performance for understanding abstract problems when exploring 3D worlds with objects that represent abstract entities [Carpenter 96].
- facilitate usability and enhance high interaction: for the navigation and manipulation of synthetic environments, [Mikroupoulos 96] states that the use of a glove with haptic feedback is a more direct approach to the interaction with virtual objects than the one provided by a mouse. The testing indicates that the use of this kind of devices improve the interaction with virtual learning environments.
- revive unreachable learning experiences: Kato's [96] work with virtual learning environments has shown that placing the users in known real places but providing them with improbable perspectives in other time, via VR, enables them to revive the original experience with fully awareness.
- stimulate high levels of involvement and give multiple perspective sensorial experiences: Dede [96] describes the use of virtual environments to provide multisensorial experiences for better understanding abstract concepts. Multisensorial interactive experiences involve the learner and stimulates understanding and learning.
- help to reconstruct and navigate through non existent environments: there are ongoing efforts to reconstruct historical places for later exploration and study in VR. The virtual reconstruction of ancient Egyptian ruins is described by Littman [96].
- foster disabled learner accessibility: transduction can be used to describe abstract phenomena into perceivable representations of any type of media, compensating the lack of any of the users' senses. For instance, there is an approach taking profit from 3D sound technology to enable visually impaired users to access information systems [Lumbreras 96].

The main issues concerning VR and learning are:

- learner desocialization: [Winslow 96] states that VR can have a draw back on the learning process because it allows the user to loose social presence.
- disturbance of task-centered learning: Grove's [96] concerns in this area is related to the growing interest of the learner in the medium and not on the content. VR by itself may not provide knowledge and can act as noise.
- evaluation of VR experiences: Littman's work [96] reflects his concerns regarding the absence of

tools to evaluate virtual environments in the learning context.
- potential damage of long vision exposure through HMD usage
- quality and fidelity of the rendering of virtual environment, and
- shortage of long-term research results

4. CONCLUSIONS

We have presented a literature review status of VR and possible impact on education. Constructivism and constructionism are the soil theories to grow a diversity of applications for learning and cognition. Diverse seminal experiences confirm a controversy about possible effects of VR on learning. The scarce number of experiences shed some light about possible effects, some of them promising others puzzling. We need more quality, quantity and variety of experiences and cheaper VR technology to start drawing some lines about learning in highly interactive environments.

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