Virtual Reality in the Educational Environments

N. Sala

Academy of Architecture - Mendrisio
University of Italian Switzerland – Switzerland
Email: nsala@arch.unisi.ch

Abstract

Virtual reality (VR) refers to real systems modeled by computer graphics that allow user interaction and movements with three or more degrees of freedom. VR is being used, in architecture by visualizing large and small scale design process, in health care by visualizing surgical process, and in training airforces by visualizing virtual air fights. Furthermore, virtual reality is a technology which can help the educational process in a variety of fields. The aim of this paper is to present an educational experience of the use of the virtual reality in two different undergraduate courses of Mathematics (Mathematics 1 and Mathematics 5) at the Academy of Architecture of Mendrisio, Switzerland (University of Italian Switzerland). To introduce the connections between mathematics, nature, arts, and architecture we have organized our lectures using multimedia technologies and some virtual objects, created using VRML (Virtual Reality Modelling Language).

2. Virtual reality in the educational processes

Starting point for our investigation is the following question: “Virtual Reality is a technology, but can virtual reality aid in education?” Many researchers believe that Virtual Reality offers strong benefit that can support education. For some, VR’s ability to facilitate constructivist learning activities is the key issue. Others focus on the potential to provide alternative forms of learning that can support different types of learners, such as visually oriented learners. Still others see the ability for learners, and educators, to collaborate in a virtual class that transcends geographical boundaries as the major benefit. In traditional instructional environments, students learn by assimilation, for example, by listening to an instructor lecture about a subject. Current educational thinking is that students are able to master, retain, and generalize new knowledge in a learning-by-doing situation. This philosophy of pedagogy is called constructivism and its supporters vary, ranging from those who see it as a useful complement to teaching – by – telling to those who argue that whole curriculum should be reinvented by students through gently guided discovery learning [7]. The major distinction between traditional instructional design and constructivism is that the former focuses on design instruction that has predictable outcomes and intervenes during instruction to map predetermined conception of reality onto the student’s knowledge, while the latter focuses on instruction that fosters the learning process instead of controlling it [8]. Educational theory and cognitive science support the exploration of VR as an educational tool. VR can present abstract information in concrete

3. Applications of virtual reality in educational processes

In this paper we will present some applications of the virtual reality in the educational process in two undergraduate courses of Mathematics at the Academy of Architecture of Mendrisio (University of Italian Switzerland). The paper is organized as follows: section 2 presents VR in educational processes; section 3 describes our educational examples of the use of virtual reality; finally, in the section 4 we have our conclusions.
forms that humans have been processing by immersing people in a visual computer-generated world. Cognitive science is another field of knowledge that guided the use of VR and multimedia technologies as educational tool [9]. Since cognitive scientists study how the human mind works, their theories can address how VR can help students learn. According to cognitive theories, VR can help humans process information and therefore learn, by making abstract concepts more concrete. According to many cognitive scientists humans think symbolically [10, 11]. At the Human Interface Technology Lab (HITLab), University of Washington in Seattle, several pilot studies had been performed to examine VR's potential in the field of education. The Pacific Science Center studies used 10 to 15 year old students who were attending a week-long summer day camp. Some of these students had extensive computer knowledge, while others were novice computer users. As part of their camp, they learned about VR. In groups of 10 or so students, they brainstormed virtual world creations. In sub-groups of 2 to 3 students, they created objects for their world along with specifications as to how the objects should be placed and move in the virtual world. Using constructivist theory, Byrne (1996) has created a virtual chemistry world to encourage students to learn by exploring and interacting with the information. Instead of sitting in a classroom and passively viewing images of atomic orbitals, students can place electrons into a atom and see the atomic orbital appear as the electron buzzes [12]. Other interesting example is the pedagogical project called EVE (Environments Virtuels pour Enfants) which involves nine partners (universities, Primary Schools and SMEs) from three countries: France, Morocco and Romania. The target of the project is to implement new cooperative working environments, and to initiate new products development such as pedagogical software for primary school. Children from different classroom and countries are involved in a cooperative work. They have to achieve a common task together, hoping that will encourage curiosity and respect in a multicultural framework, at a children level, and not only [13].

3. Our examples of the use of VR

In our case, the virtual reality is an educational tool which we have used in support to the traditional educational methods in two different courses of Mathematics (first and fifth year). For example, in the course of Mathematical Thought (first year) VR is a good medium for making abstract concepts concrete [14]. The difficulty of understanding abstract concepts is well researched [15]. "Students' misunderstandings and misconceptions in school sciences at all levels constitute a major problem of concern to science educators, scientist-researchers, teachers, and, of course, students" [16]. This difficulty is attributed to the abstractness of the scientific topics [17, 18]. In our case, the topic of polyhedra and the their interconnections between nature and architecture is an excellent example of an abstract topic that is difficult to learn [3]. Virtual reality has been used by our students in different ways (e.g., in the traditional lectures and in the laboratory activities) [19]. We have created virtual objects, and the students:

- have observed and rotated virtual platonic solids from the different points of view (outside and inside the virtual objects),
- have known and to manipulated virtual polyhedra,
- have created some virtual objects using VRML (Virtual Reality Modeling Language),
- have analyzed and manipulated the fullerene molecules (C60 and C70),
- have observed the geodesic domes and their analogy with the fullerene molecules,
- have studied the symmetry presents in the crystals.

In the course of Mathematics 5, the virtual reality has been analyzed as a medium to create some virtual buildings and some virtual worlds. During this course we have emphasized the connection between virtual reality and the fractal geometry, for example to realize the virtual worlds (e.g., to create trees, mountains, and special effects using fractal algorithms). In the next future, we will use an immersive virtual reality to create virtual visit in the buildings in agreement with other researchers [20, 21].

4. Conclusions

Virtual Reality has a definite role to play in education, if merely from a motivational point of view. There are many subjects that virtual reality can fill a void that cannot be currently covered. For example, subjects that rely heavily on visualization of abstract concepts are a prime topic for VR use. Virtual reality technology permits to the students to observe events at an atomic or planetary scale, see the effect of changing physical laws, visualize abstract concepts, visit environments and interact with events that distance, time, or safety factor normal preclude [12, 22, 23, 24, 25].

VR technology may offer strong benefits in education not only by facilitation of constructivist learning activities but also by the potential to provide alternative forms of learning that can support different types of learners such as visually oriented learners. These characteristics permit virtual worlds to support a wide range of types of experiential learning that is otherwise unavailable [7]. However, this should not be extrapolated to the idea that VR should be used for every aspect of education. While VR may offer something for every subject, the cost of the system, especially at current prices means VR is a heavy resource sink. During our studies, we have observed that the use of virtual reality for teaching offers series of advantages, for example the efficacy, and a high level of interactivity, in agreement with other researches, where
the students have an active role inside their learning process [24, 25, 26, 27].

5. References