Multimedia and Virtual Reality Technologies in Architecture Education

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ABSTRACT

The evolution of multimedia and Virtual Reality (VR) technologies can open new educational opportunities in architecture education. This paper describes an example in this educational field.

Keywords: Hypertext, Multimedia, Hypermedia, Virtual Reality, Education, Architecture.

1. INTRODUCTION

Multimedia is the use of several different media (e.g. text, graphics, animation, audio, video, and interactivity) to convey information. With increases in performance and decreases in price of the hardware, multimedia is now commonplace. Therefore, this technology could offer new opportunities in educational environment, for example integrating different media in the teaching path.

Virtual Reality (VR) is another technology which could have great potential in the school of the next future. It is an environment that is simulated by a computer. The origin of the term "virtual reality" is uncertain though. It has been credited to *The Judas Mandala*, a 1982 novel by Damien Broderick where the context of use is somewhat different from that defined now. As a medium, VR has three defining characteristics [1]. It is interactive (users can interactive with models), spatial (models are represented in three spatial dimensions), and real-time (feedback from actions is given without noticeable pause). VR can be classified according to its methods of display; we have immersive VR (which involves a high degree of interactivity and high cost peripheral devices, for example the head mounted displays), and non-immersive VR in the form of a windows into a virtual world displayed on a computer's monitor [2]. A virtual reality system has the following three primary requirements [3]: immersion (which permits to the user the physical involvement, capturing exclusive visual attention and responding to three-dimensional input. For example, through a head-tracker, 3D mouse, data glove, or fully instrumented body suit); interaction (through the three-dimensional control device to "navigate" in the virtual environment); and visual realism (which is a representation of the virtual world using computer graphics techniques). This paper describes an application of multimedia and virtual reality in a faculty of architecture, where these technologies are used in the teaching paths in different courses.

2. MULTIMEDIA AND VIRTUAL REALITY IN ARCHITECTURE EDUCATION

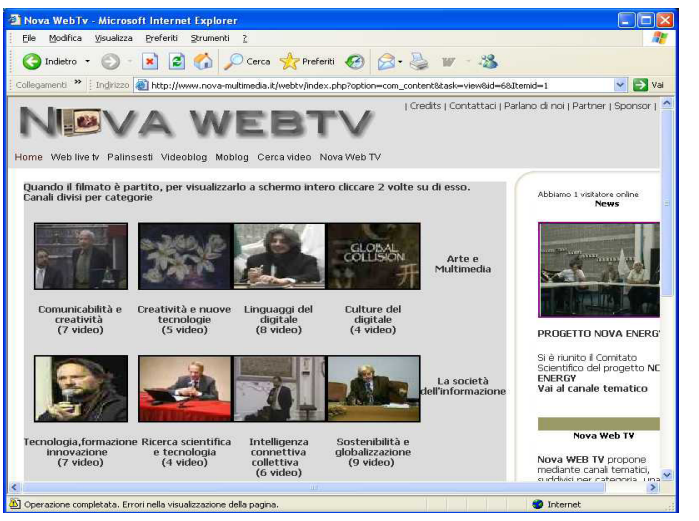
Multimedia are modifying the ways in which we share information. In particular, it is affecting methods of teaching and learning [4, 5]. We analysed the teaching impact of multimedia technologies in a faculty of architecture, in particular in two courses: one of mathematics and the other dedicated to the computer science. The investigations followed the question: "How to organize some academic courses using multimedia solutions and virtual objects integrated in the teaching path?" To answer it, two courses, specifically conceived for the Faculty of Architecture at University of Lugano (Mendrisio, Switzerland), have been organized starting from 2000 [6]. In these courses, the traditional lectures were integrated by the use multimedia as a teaching strategy. First course, named "Mathematical thought", was inserted in the first year of the studies until 2004 (5 credits ECTS, European Credit Transfer and Accumulation System). It introduced basic facets of mathematical thought connected to the arts and to the architecture (e.g., the symmetry, the proportions, the golden ratio, the curves and the surfaces, the fractal geometry and the complexity in the study of the urban grown). The second course, named "New media for the architecture" (third year, 5 credits ECTS), is actually in the curriculum of the faculty. This course proposes how new media and the graphics solutions can create new architectural shapes, for example hypersurfaces, and a new kind of architecture (for example, cyberarchitecture transarchitecture, and hyperarchitecture).

The traditional lectures were integrated by the use multimedia, because 60% of students today are visual learners [7, 8]. This category of learners may benefit most from multimedia presentations, which combine words with pictures and audio can help to redefine the teaching methods [4, 7, 9].

The lectures were organized using hypertexts and multimedia presentations, didactic CD-ROM, animations in Java language, scientific documentaries, data streaming, dedicated to the information and communication technologies. Figure 1 shows the home page of Nova Web TV (http://www.nova-multimedia.it/webtv/) that is a section of the portal Nova Multimedia (http//www.nova-multimedia.it), which collects interviews, "media book", and scientific data streaming dedicated to the connections between arts, new media and computer science. "Media Book", available on line in pdf format, collects the theoretic contributes of famous contemporary scientists coming from the international academic and scientific panorama. We used some interesting "media book" and the interviews, present in the section Nova Web TV, integrating their in the teaching path. The lecture hall was provided with the technological structures which was allowing to use different media in the lessons. Their contents were integrated in the teaching path.

Other technological tool integrated in the teaching path was the Virtual Reality (VR). In recent years, VR has emerged as a revolutionary human/computer interface, challenging everything to which individuals are accustomed. Research institutes around the world have demonstrated the potential of VR systems as a visualization tool and, as technology continues to improve, it is proposed that VR systems will become increasingly pervasive as tools for education [10, 11]. Thus, inside our educational environment, the virtual reality have been used in two ways. One is to insert this technology in the process of teaching. For example, to

Figure 1. Home page of Nova Web TV (http://www.nova-multimedia.it/webtv/)



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explain the 3D surfaces some 3D virtual objects have been created, using VRML (Virtual Reality Modelling Language). The virtual objects can be observed in the theoretical lessons and it is possible interact with their during the laboratory activities [6]. The students manipulated the polyhedrons, observing them from different points of view. They also analysed the connection between virtual polyhedrons, the nature and the architecture (for instance, looking for an analogy between the polyhedron forms, the forms of Radiolaria, a kind of protozoa, and the geodesic domes). They studied the crystals' shapes and their symmetry, with virtual crystal created using VRML, and they came in virtual buildings to observe their geometrical components and their analogy with natural shapes.

Second way is to integrate virtual reality in the design process, for example to realize virtual models of buildings. It has been developed in the laboratory activities of the course of "New media for the architecture", where the students use the virtual reality technology, and they present their architectural projects using hypermedia presentations and "virtual tours" inside them. This educational approach is begun in 2001 and it continues everything today. During these five years, the students evaluated the teaching process through multiple choices tests. During the exams, we evaluated the quality of the teaching method analysing the students' school profit. Important deductive considerations are shown.

In brief:

1. multimedia assists the teaching process (in fact, different communication codes in a lecture make more incisive the explanation);
2. the lectures are now more interactive (for example, in the laboratory activities the students can create virtual objects and they can navigate in didactic hypermedia); and
3. the students got good grades in the exams.

Some of the possible benefits of VR on the design process and practice of architecture could be:

- the ability to test ideas in "real time" in a "three-dimensional" space during the design process;
- communication of ideas, and the power to illustrate the projects;
- the elimination of much of the guesswork in design;
- braver and better designs; and
- the integration of the design process.

These deductive considerations are in agreement with recent studies which have recognized that virtual reality offers benefits, and it can support the education and the design project [1, 10, 11, 12, 13, 14, 15]. In particular, in the faculties of architecture where the design is affected by the medium used [1, 16]. Henderson (1999) notes that: "Young designers trained on graphics software are developing a new visual culture tied to computer-graphics practise, that will influence the way they see and will be different from the visual culture of the paper world" [17, p. 57]. Architects who have grown up with digital media and virtual reality will be expert users of interactive, spatial, real-time environments [1, 18]. These designers will solve problems using representations that do not emulate paper-based media.

3. CONCLUSIONS AND FUTURE TRENDS

Educators and researchers look for more efficient ways of teaching and learning. Furthermore, it is proposed that different media assists in the teaching processes. Kozma (1991) argues that media which promotes cognitively relevant characteristics such as symbol systems and processing capabilities, enables students to process information more effectively and understand it more fully [4]. Bagui (1998) has observed that, because multimedia allows guided discovery, students involvement in learning is increased, understanding is greater, and the intrinsic features of the computer (e.g., immediate feedback, animation, and individualization) are more likely to motivate students to learn [19].

We are proposing that multimedia and virtual reality can assist the teaching process, in agreement with other researchers [4, 12, 13, 14, 15, 19, 20, 21, 22]. Therefore, all subjects of our courses have been organized implementing multimedia solutions [6, 23]. In fact, the use of multimedia technologies in the traditional lectures have promoted the following pedagogies including:

- an in depth study of the platonic solids
- application of the perspective
- to observe the fractal forms
- to manipulate some virtual object in 3D (e.g, virtual geodesic domes, or virtual crystals).

We observed that the hypertexts facilitate human learning. Recent researches show that a more tree-like or hierarchical text structure limits navigational difficulties as compared to a purely heterarchical structure [21, 22]. During the laboratory activities we noted that in the students' navigation in hypertext some students can only interact with pages passively, by reading and clinking the links. For this reason, it is important that in the laboratory activities the presence of the professorial assistants, it is important because their facilitation can illustrate the correct and active navigation inside the document organized as hypertext [23].

In order to effectively apply VR as an educational tool in architecture, and in other technical areas, a number of simulation difficulties have to be identified and solved. For example, to maintain high frame rates on personal computers and the low resolution of inexpensive viewing devices. One of the main aims of VR is to create virtual worlds and virtual environments in which humans can interact together. The problem of the interaction with other users and with virtual objects will raise in the next future. The realism presumably will play a major role in the programs' success and likely will prove positive in the future. How to create the virtual worlds? Some virtual worlds will be oriented certainly to the educational field and other for training, works or fun. Architects will potentially help to make the virtual world a pleasant and stimulating place to work and live in, with a good quality of life. This will require people who understand the psychological effects of the spaces, generated by the computer, on people inside them, and the architects have to prepare themselves to this new work opportunity. Architects as designers of Virtual Worlds will be required to make these environments interesting, rich, and engaging places. Therefore, it is important to prepare a correct training on the use of VR in the faculties of architecture [1, 16, 24]. Some architectural theorists are looking at VR as such an inhabitable alternative reality. Whyte (2002) affirms: "they describe objects in interactive, spatial, real-time media as though they existed in a new form of space, rather than in spatial representations and look at Novak (1996) terms the vitality of architecture after territory" [1, p. 46]. VR is also connected to the cyberspace. Novak argues that: "Cyberspace as a whole, and networked virtual environments in particular, allow us to not only theorize about potential architectures informed by the best of current thought, but to actually construct such spaces for human inhabitation in a completely new kind of public realm" [25]. For the architectural education, virtual reality will become the place to go to do things that you could not normally do in architect-designed buildings.

The educational approach presented is only a small step towards locating a correct fit, or the integration between new media, and traditional media in the teaching process [26]. It also uses Virtual Reality. As such it can promote more interesting and interactive the lessons, instead of the traditional educational methods [26]. It is also proposed that this approach will accommodate different learning styles, favouring the visual learners. This paper is a set of suggestions emerging from our teaching activities. With them we hope to give an aid to the teachers that want to use multimedia and virtual reality technology in their work.

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