Learning Objects and Virtual Reality in Distance Education and its Aspects of Interactivity, Immersion and Simulation

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Abstract

This paper presents an analysis on the use of Virtual Reality in Education, focusing on aspects of interactivity, immersion and simulation, using the Virtual Reality Modeling Language (VRML) and the concept of learning objects. It also presents a prototype developed to illustrate and evaluate this proposal.

Keywords: Virtual Learning Environments, Learning Objects, Virtual Reality, Distance Education.

Introduction

Lévy says "Every and any serious reflection about the future of their education and training in cyberculture systems is on a previous analysis of the mutation of the contemporary relationship to knowledge" (Levy, 2000), because, as Vaz (2000) has pointed out, information and communication technologies are increasingly
responsible for present and future shaping of our society, so Lévy (2000) completes by saying that intellectual technologies supported by the cyberspace (information and communication technologies) enlarge, externalized and change many human cognitive functions like memory (databases and hypertext), imagination (simulations), perception (digital sensors, telepresence, virtual reality), reasoning (artificial intelligence), and favor new forms of access to information.

These two authors present a reflexion about the applications of digital technologies (information and communication) in the context of modern life and consequently in the processes of learning and education. More than identify problems and point out solutions for current educational models, they suggest a demand for new ways to deal and experience the knowledge and information, using technology we already have.

This article presents an analysis about the use of Virtual Reality in Education, using Virtual Reality Modeling Language (VRML) and the concept of Learning Objects. It also presents a prototype developed to illustrate and evaluate this proposal. The analysis presents part of a series of studies for the educational use of Virtual Reality developed together to the Group of Virtual Reality from the Computational Methods in Engineering Laboratory- LAMC / COPPE / UFRJ, in partnership with the Research Laboratory of Information and Communication Technologies LATEC / UFRJ.

**Virtual Reality in Education**

Virtual reality is based on the use of interactive computer interfaces in order to create in the user a sense of reality. The aspects that allow Virtual Reality create this sensation of reality are: interaction, immersion and navigation. The potentiality of the use of Virtual Reality in education is exactly based on these characteristics, because they allow the learner to explore environments, processes or objects through interaction, immersion and navigation, in other words, within their own study environment. They experience the knowledge in an interactively way and learn about a subject from his immersion in the own context of this subject.
Other benefits are seen with the use of virtual reality in education. Clark [2006] suggests that Virtual Reality can be used to: (1) make learning more interesting and entertaining in order to improve motivation and attention, (2) reduce costs when using the object and the real environment is more expensive than the simulation, (3) enable to do things that are impossible to be done in the real world. For example, exploring a planet like Mars, traveling inside the human body, making underwater or in caves explorations, visiting too small places to be seen (molecules) or too expensive or too far, or still because that place is in the past (historical places), (4) accelerating learning, (5) integrating skills and knowledge, (6) increase retention by strengthening: (7) increase retention through realism (8) improve the transfer of learning to the real world, (9) accessing the learning content anywhere and at any time (in case of use of Virtual Reality on the Internet), (11) eliminating risks and hazards to the environment, the teacher or the learner. Because of this last benefit, risk reduction, simulations have been increasingly used in military training, in medicine and aviation, in fields where decisions and actions of learners can cause damage or deaths.

We conclude that Virtual Reality is one of the possibilities that information and communication technologies offer to treat the educational content in order to captivate the attention of the student, interfering positively on motivation for learning and learning retention. In order to get a better advantage of the possibilities presented by Virtual Reality in the educational field, we must, however, identify suitable methods and techniques for the construction of these learning contents and test its efficiency.

Below we analyze the conceptual model for the Learning Objects construction from one of the technologies for the creation of Virtual Reality which is the Virtual Reality Modeling Language (VRML).
Learning Objects

Learning Objects can be understood, according Muzio et al (apud Bettio and Martins, 2004) as a reusable piece of information independent of the media, which is constituted with a beginning, middle and end.

One of the major advantages of using the concept of Learning Objects is the possibility of reuse. In order to be possible the reuse, indexing patterns are created for the storage and search of objects. For effects of this study, we adopt as an example of possibility, the recommended standard by RIVED - Virtual International Network of Education (program of the Distance Education Secretary - SEED connected to MEC which aims to produce digital educational content in learning objects forms). The network RIVED adopts and recommends the use of an international standard based in attributes, adopted by the Global Learning Consortium, Inc., and The Dublin Core Metadata Initiative. Figure 1 shows an example of RIVED index cards.

![Figure 1: Example of RIVED learning objects cards. Available at http://rived.proinfo.mec.gov.br/site_objeto_lis.php?desprocura=f EDsica%](http://rived.proinfo.mec.gov.br/site_objeto_lis.php?desprocura=f EDsica%)
Virtual Reality Modeling Language - VRML and its use in education

Virtual Reality Modeling Language (VRML-Virtual Reality Modeling Language) is a language used to describe objects in three dimensions and combine them into scenarios of virtual worlds. With VRML we can create interactive simulations that incorporate movement physics, for example, gravity sensation.

VRML was designed as a language for the Internet, then its use is extremely efficient in educational applications. As VRML can build complete websites with three-dimensional interactive objects that can be linked to files of text, audio, video, or even to other sites and worlds in VRML.

In order to view VRML files you must perform the installation of an auxiliary software (plug-in) called Cortona, developed by Parallelgraphics company, and freely available on the Internet at http://www.parallelgraphics.com/products/cortona_/download/iexplore/.

VRML becomes advantageous for the creation of educative applications in Virtual Reality, by the possibility that this language provides of availability and sharing of documents via Internet and also for being a language of free use, similar to the language normally used in Web pages building, the HTML.

The main challenges for the use of VRML in educational context are: (1) to reach the graphics quality, because one of the main goals of good design is to establish credibility (Nielsen, 2000). (2) to understand the VRML language, because, although editors such as Cosmo Worlds 2.0 facilitate the creation of three-dimensional objects, they are still little intuitive and require from the developer a significant knowledge of the language.

Within this research, and in the context of language experimentation to build the prototype, it was outlined a project methodology, we describe below. This methodology aims to offer a systematization and, thus, face the challenges of making VRML more accessible to educational means.
Methodology for the creation of learning objects in Virtual Reality

The methodology proposed here, for VRML use in educational applications, is based on four main attributes: the teaching model of Meaningful Learning of David Ausubel, the author focuses on the teacher, the format based in Learning Objects and a modular architecture for the use of VRML.

Pedagogical Model of Meaningful Learning of Ausubel David

We adopted in this study, the pedagogical model of meaningful learning of David Ausubel (1980). This model was chosen by its excellent adaptation to the context of learning in Virtual Environments, namely: (a) a body of knowledge is much easier to understand and remember, if it is related to pre-existing ideas in student cognitive structure, the "Meaningful Learning", which, according to Ausubel (1980), facilitates learning and motivates students.(2) The "ausubelian" theory provides a reference system of learning that does not need substantially to change the current model of teaching and learning. The traditional educational structure in the classroom is focused on what Ausubel calls receptive verbal learning of a knowledge body by the student.(3) Another feature of Ausubel's theory, which makes it favorable for the use in Virtual Learning Environments is the student-centered learning propose.(4) Ausubel also states that the best teaching strategies are those that allow the changing, by both the teacher and by the student, of the learning time.(5) Another major contribution of Ausubel's theory, applicable to Virtual Learning Environments is the concept of the Previous Organizers, which are introductory materials presented before the own material to be learned, but containing a higher level of abstraction and generality (Moreira , 1983). The adoption of the "ausubelian" Previous Organizers represents a possibility of relaxation on the exhibition of didactic material that can be exploited in an exceptional way when ally to the use of virtual reality. Advance organizers can be used to supply the deficiencies of a student, favoring a more personalized learning, or of a group of students, provided the patterns of student learning or student group have been previously observed.
Author focused on teacher

In the context of his author, we believe that the model must be focused on the teacher, in the expression of subjectivism, of common sense, of creativity and of specific competence of the teacher-author that is manifested at the moment when it builds learning content that will be published for students. Lucena (1999) notes that the major problem found by teachers who wish to publish their materials on the Internet is the learning of programming languages, necessary to that task; and reinforces the idea that for the teacher is enough to dominate his knowledge field. To these statements, we would add that preparation of good contents for e-learning also requires an appropriate language for the Internet: a set of skills that are not part of teacher training, thence the difficulty found by them, at least until now.

We have observed that the alternative to supply this lack or difficulty is the use of work teams formed by instructional designers, illustrators, revisers, web designers and flash designers. However, this methodology takes away teacher's autonomy, getting him inserted in a kind of assembly line, making only the part of content creation.

Misanchuk (1992, p.2), in the context of the printed materials design, gives us another idea, stating that "It is not to expect too much from educators produce professional-looking materials. And that's what they want to when they have the opportunity to do so. "He believes that educators must not miss the opportunity to create themselves their learning materials. Along with this, we observed a trend of graphical interfaces to increasingly provide autonomy to the common user.

Who used computers before the advent of graphical interfaces, should remember that it was necessary to memorize a good number of commands to operate the operating system (DOS) and text processing software. What we need today, with the advent of graphical interfaces and plug-and-play devices, is a greater accessibility. It's on this thread that we conceive the authoring for virtual environments, and thus, we propose a model for the VRML use in educational applications, following the trend of offering greater autonomy to the user.
Architecture of learning objects built with VRML

During prototype construction, we observe that for the materialization of the outlined concepts in the project methodology gets necessary the creation of a modular architecture for the virtual worlds sizing in VRML that is composed of: specifications for virtual worlds sizing and object scale, three-dimensional object libraries and of pre-programmed interactions.

This architecture must be able to offer a greater degree of precision and systematization of the learning objects developing process and provide conditions for the reuse of its components in other objects and virtual worlds.

Development of the learning object prototype with VRML

Figure 2 shows an image of the learning object prototype that was developed with VRML in the context of this research. It is composed by a DNA molecule three-dimensional model to be used in the chemistry or biology learning context. It is shown through the plug-in Cortona, from Parallelgraphics, which makes it possible to display the VRML world inside the browser window, in this case Mozilla. Cortona provides a table in the center of the page where navigation controls allow learner to explore the object. It is also possible to change the viewing angle, getting closer, getting further and rotating the object by using only the mouse. Another possibility offered by VRML, and that was used in this prototype, is the insertion of links in the environment and in the objects that allow to available on side windows (gray rectangle shown in Figure 2) of HTML page, information about the study object.
In order to develop the Figure 2 prototype, we used the COSMOWORLD 2.0 VRML editor from Silicon Graphics. It offers some ease in the preparation of virtual objects, by providing ready primitives geometric forms, being the designer responsible to attach them to obtain the desired shape and Preprogrammed interactions, however, it is still necessary, sometimes, interact directly with the programming code. The using of a proprietary editor, such as Cosmo Worlds 2.0, is optional, because it is possible to model objects and virtual worlds with just a text editor to type the code. Figure 3 shows a Cosmo Worlds 2.0 editor interface image.
Final Considerations

The design methodology developing is one of the challenges for the development of Learning Objects using Virtual Reality, because even with the editors use, the content objects creation in VRML still requires expertise knowledge which are little available for teachers, even he has some proficiency in computers.

The methodology outlined here also involves a deepening, in the sense of offering to teacher's authorship fundamentals that gets it possible scripts creation for these virtual worlds that foreseen solutions of interactivity, of narratives styles (Murray, 1993) and of suitable color use for diverse age groups and for the goals you want to express. Language further studies are still foreseen, within this research, to do so, such as films and games that can be inspiring in this context.

The changes that occur in the means of production, service and communication require new ways of conceiving educational content to integrate and getting them closer to the learners context. Virtual Reality appears as a possibility for the creation
of more creative and more integrated educational content with the tendency of immersion and interactivity that information and communications technologies offer us.

In order to get a better use of the possibilities offered by Virtual Reality in the educational field, we must, first of all, identify the most suitable techniques and methods for the learning contents construction and test its efficiency. VRML appears as an excellent tool for verification of these possibilities, because its use occurs in an online environment, and it is a free software, what represents a significant gain in terms of production costs.

The development of the prototype showed that the main challenge for the use of Virtual Reality in education is quality graphics coupled to the significant knowledge of programming language, because even the available graphic editors are still limited and difficult to use. There is also the need to expand the study of learning theories, applicable to the virtual environments context, to evaluate other editors for VRML, beyond Cosmo Worlds 2.0 and to deepen the proposed project methodology, especially referring to the learning objects architecture item.

References


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