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DESIGN OF LEARNING ACTIVITIES FOR 3D TECHNOLOGICAL ENVIRONMENTS

1. INTRODUCTION

On-line teaching and technology broaden the spectrum of educational options and are a qualitative leap forward. The digitalisation of educational spaces involves changes to both professional activity and educational needs. Going beyond the physical conception of a university educational space to a more conceptual conception opens up new, more diverse, possibilities for teaching, more in tune with students nowadays. This new teaching model is not based on control by those who teach but on self-management by those who learn, and it requires a scenario to be designed in which students direct their own activity towards what they really need.

The graphic design of visual communication in a three-dimensional environment is an incipient but essential field for the presentation of digital contents in any discipline since the scenarios, the setting, the graphics, the models, the sounds and the colours will largely determine whether users will decide to remain in the 3D environment. Therefore, it is important to establish a design methodology that will establish the technological instruments to be used; defining a team with specific roles and functions; optimising development time, reaching agreements about design and, therefore, avoiding reprocesses and achieving the desired product.

2. MODELS FOR DESIGNING LEARNING ACTIVITIES IN 3D ENVIRONMENTS

When designing educational spaces in 3D environments which largely use simulations, a range of principles must be borne in mind that, in general, should not depend on the particular content to be studied. The environment should enable students to communicate and collaborate since the environment must be connected to the network to facilitate distributed interaction and cooperation. In the 3D environment, the students are represented by avatars which, in general, simulate human figures that all have the same image and same physical structure. These avatars are the students' eyes and hands. The environment must allow for tutorials, feedback and student evaluation by means of case studies. The students and the groups in which they work must be able to speak, act, create and review their actions in order to be able to solve the problems that they are faced with. They must be able to take decisions in real time

about all the situations in which they are immersed within this “invented” digital world so that it can be active, participatory and dynamic. All this is possible only if the environment has the appropriate symbols and tools that enable them to interact and “live” in this simulated world.

Various things need to be borne in mind when designing the activities. Firstly, the virtual environments and settings for teaching and learning need to be designed and developed from a multi-disciplinary point of view and they also need to be linked to the uses that teachers and students make of IT to achieve their learning objectives. And secondly, these activities need to be able to adapt to the virtual environments for teaching and learning in the short and the long term, and the evolution of social software, the Web 2.0 and the 3D immersive environments or virtual worlds.

One other thing that it is essential to take into account is that the design of a virtual environment for teaching and learning does not end with the selection of the technological resources and the plans for using them. The use that the participants make of these resources and their evolution must also be monitored, the extent to which the educational objectives for which they were designed are achieved must be evaluated, and they must be accordingly reconstructed and adapted. In this regard, collaboration and exchange between end users (mainly teachers and students), instructional designers and technological developers is fundamental if virtual environments for teaching and learning are to be optimised (Onrubia *et al.*, 2006).

3D virtual environments must include the following elements:

- 1) a space for creating, managing and delivering sequences of learning activities with proposals made by teachers that students can select and develop;
- 2) a range of mechanisms that enable students to identify the characteristics and variables of the task proposed so that they can adapt their approach individually and collectively;
- 3) a range of automatic functions that provide information to both teachers and students about who does what, how, when, with whom and with what results, so that self-regulatory processes can be implemented and learning support can be offered at both an individual and a group level;
- 4) a dynamic structure that enables students to move quickly and efficiently from individual to group work, maintaining the identity and specificity of both work spaces.

Various models have been put forward to explain the process that must be followed to design activities for 3D virtual environments. For example, Baños and Rodríguez García (2012) proposed the scheme below (see table 2) at the 5th Symposium of Societies faced with the Digital Challenge.

Process for designing and setting up e-activities in 3D virtual worlds
1. Choice of a virtual world
2. Construction and/or management of appropriate spaces in the immersive environment
3. Creation and management of the teaching self
4. Design and development of a learning strategy for the immersive experience: design of suitable activities
5. Training of students in the essential competences for controlling the immersive environment

Table 2. Scheme for designing activities in 3D virtual environments
Source: 5th Symposium of Societies faced with the Digital Challenge

Salmon (2004), on the other hand, proposed a different model that has a similar structure and which also has five stages.

<p>Stage 1. Access and motivation</p> <p>In this stage the participants access the virtual environment and acquire the competences required to use it. In the virtual world they need to acquire some basic competences so that they can manage their avatar's interaction with the environment and with other users. These competences are very similar to those required in the real world: mobility and communication. The presence in this phase of a teacher or tutor who can move around the virtual environment with ease is fundamental if orientation problems that may lead to a loss of motivation are to be solved. Teaching support must be designed so that asynchronous and synchronous solutions can be provided.</p>
<p>Stage 2. Socialization</p> <p>In this stage, the students configure their identities in the virtual World and begin to interact among themselves and with the teachers. Participants get used to using the tools of the virtual world to relate to their peers and a learning community starts to take shape that allows on-line, geographically dispersed students to feel that they are working together on a common task. The technologies that support these platforms of communication and social relations generate or facilitate instances of socialization, which is the first step in configuring a coherent work community. For a teaching-learning activity to be constructed in the virtual world, there must also be a tangible interaction by the teacher.</p>
<p>Stage 3. Sharing information</p> <p>This is the moment at which students are presented with the content of the forum and begin to exchange information about the main activity proposed. Salmon (2004) points out that the increasing amount of information in this phase and the need to work with it can cause a feeling of saturation in the students. They begin to develop a variety of strategies to cope with the requirements and the time involved in understanding the material.</p>
<p>Stage 4. Construction of knowledge</p> <p>According to Salmon's model (2004), in this stage the group members relate to one another through discussion and communication. The students do not limit themselves to receiving or providing information but take active part in the process of constructing knowledge. Interaction is highly participatory and wholly learning oriented. They record their ideas, argue and counter argue about the proposed content, and there is an exchange of messages that take the form of a dialogue and whose outcome is active learning. And it is precisely in this stage, the most important one in the teaching-learning process within an e-learning system, that an immersive activity to be carried out synchronously in a virtual graphic environment becomes an educational tool that has features that make on-line teaching richer and more functional. In the present experiment, it is at this point that the main immersive activity is carried out: a synchronous debate about a particular topic that has been worked on in the teaching units and applied to a case.</p>

Stage 5. Development

In this last stage, the students are asked to find advantages of the technological platform they have used and how it could be applied in other contexts. They are also asked to provide a critical vision of the environment and how it works.

Zapata, Marín and Vélez (2012) also put forward the following methodology for designing virtual environments for educational purposes.

1. Composition of the team

The team needs to be interdisciplinary so that it can cope with all the pedagogical, technological and visual communication issues involved in creating an educational environment; therefore, the following roles need to be defined:

- Graphic designer for 3D educational environments. This person is in charge of creating, digitalising and editing two-dimensional images, as well as diagramming and illustrating all the pieces required. He/she is also responsible for making sketches and models of the three-dimensional environments and pieces, joining them up in such a way that the whole visual composition helps the 3D virtual environment users to have a pleasant and aesthetic experience.
- Thematic expert. This person understands the subject that is to be taught in the 3D virtual environments. He/she is in charge of drawing up the content of the knowledge unit and illustrating the concepts to be developed that may become graphic elements in the virtual world.
- Instructional designer. This person accompanies and guides the thematic expert in planning, designing learning activities and defining teaching resources.
- Technological consultant for 3D virtual environments. This person decides which virtual world platform is to be used for the project and is in charge of coordinating the integration of the elements provided by the graphic designer for 3D virtual environments and the work done by the programmer.
- Programmer for 3D virtual environments. This person is in charge of developing the software components for the platform in accordance with the objectives of the project.

2. Recognition of the technology to be used

The aim of this stage is to understand the possibilities and the limitations of the platform selected so that in the subsequent stages the functionalities that the technology provides can lead to the outcomes that the project was designed for.

3. Familiarity with the interface

The graphic designer for 3D virtual environments must explore and use the modelling tools available in the technology chosen in order to understand all of its possibilities and strike a balance between functions, imagination and creativity. It is essential for functionality to prevail over aesthetic aspects: design should not hinder function. In this stage it is important for the designer to investigate and explore other software that can supplement the 3D design and which is compatible with the technology that is to be used.

4. Definition of scenarios

In this stage the thematic expert and the instructional designer meet to decide how many scenarios are required to comply with the needs and expectations of the project, the context, the period and the style that will be simulated in the 3D virtual environment. Three essential scenarios have been defined for teaching and learning environments in virtual worlds:

- Presentation of content. This scenario is the avatar's entrance to the 3D virtual world (home) where the elements for displaying the content are defined (the architecture, the graphics and the setting). During this stage, the thematic expert and the instructional designer present the visual communication requirements for the content of the knowledge unit, and define how users navigate the site and the resources to be published (images, texts, animation, links to documents or websites, etc.).
- Activity environment. This space is used to list the activities that the students must do in the knowledge unit to fulfil the learning objective. The scenario and the setting of this environment will depend on the theme chose by the teacher. The activities can be put forward in the content scenario or a separate scenario, depending on the teacher's preference.
- Meeting space for participants. This is the place where the avatars can interact socially. It can be used by teachers to meet with students at pre-arranged dates and times.

5. Sketches and white paper

It is suggested that in this stage at least three sketches are made: top view, front view and side view. They will be checked, adjusted and approved by the thematic expert and instructional designer. The concept art must include a map of the land on which the 3D scenarios are going to be designed. The map must be a bird's eye view and take into account the relief that the scenario will have, the architectural design of the constructions and the design of the setting elements. The white paper must be based on the special features of each project (in this case a knowledge unit).

6. Preparation for the production of scenarios

Before the scenarios can be produced, the avatar must be personalised and the land on which they are to be built levelled.

7. Production of scenarios

Before the setting elements that are to go in each scenario can be created, the pre-determined area of the 3D virtual world must be modified.

8. Construction of the setting elements

Graphics must be produced that can be part of the scenery or setting.

9. Final adjustments

Before the product can be finalised, it must be reviewed by the thematic expert, the instructional designer and the technological consultant.

Bustos and Coll (2010) point out that the design of a teaching and learning virtual environment does not end with the selection of the technological resources and the planning of these resources. The use that the participants make of these resources must be monitored and the degree to which the objectives for which they were designed have been fulfilled must be assessed. Subsequently the original design must be adapted. In this regard, Onrubia (2006) considers that it is fundamental for the end users (teachers, students, instructional designers, technological developers, etc.) to collaborate and interact if virtual teaching and learning environments are to be optimised.

Bustos and Coll (2010) consider that 3D immersion environments must incorporate:

1. A space for creating, managing and displaying sequences of learning activities put forward by the teachers so that students can select them and carry them out.
2. Mechanisms that enable students to identify the task proposed so that they can carry it out individually or in a group.
3. Automatic functions that provide information about who does what, how, when, with whom and with what outcome.
4. A dynamic structure that enables students to move readily from individual to group work.

2.1. The role of symbols and learning tools

From the users' point of view, it is essential to analyse the roles and functions of the different symbols and objectives that are to be part of the 3D world

Development of the signifier: a variety of 3D mechanisms (authors, objects, etc.) are designed to fulfil the objectives of human beings. Some of them are means to advance towards the objective of human activity while others are designed to reflect on this activity.
Exchange processes: some 3D mechanisms and human actions and knowledge among the students that participate in 3D environments. Other 3D mechanisms are means for object exchange.
Role taking processes: some 3D environments mediate the division of such tasks of responsibility as joint decisions, commitments and work plans.

Kränge (2000) identified three relationships that characterise the 3D environment:

Actor-object relationship: makes it possible for students to act on objects in the 3D environment. They directly manipulate objects by clicking, lifting or moving them. The actor-object relationship provides information on how a task has been completed. This allows students to internalise the images, which reduces the need to metacommunicate all the interactions.

Object-object relationship: the manipulation of one artefact affects the position of another artefact. The object-object relationship has a twofold effect on collaborative learning. On the one hand, the results of individual actions on an object are displayed, which gives significant information that affects future actions on the division of tasks and discussion of these tasks. On the other, it is essential to create a good collaborative environment, which is always much better than an environment that only permits tasks to be executed. It provides teachers/trainers with information about how students interact with the environment, how they have completed all the actions and how they have taken the decisions at the very moment they do so.

Actor-actor relationship: is based on social interactions and an extension of what Gutwin (1995) called social conscience. Krangle (2000) also argued that the efficient execution of a task is not sufficient to improve the learning effects of 3D environments. In other words, the effects of collaborative learning begin to be optimal when the virtual environment provides opportunities to discuss the tasks that are being or have been carried out. The possibilities of interaction in the environment need to be optimised to stimulate students permanently, to encourage personal responsibility and to prompt discussion of the whole decision-making process. If these environments are to be used in educational processes we must define exactly what their role is to be in this process so that it can be guaranteed that students will acquire the predicted competences-

2.2. Types of tools to be used in simulation activities for teaching

Most of the technological devices that students use from an early age have more to do with an active process of interaction with the tool than with processes of passive reading. Likewise, they have all become technologically literate on the basis of the image. EDUCAUSE (2006) published an interesting report on this issue and identified six areas that must be taken into account when systematising tool types:

Social computing: computer applications designed to facilitate interaction and collaboration

Personal broadcasting: based on audio and video. This has been made possible thanks to the greater simplicity of the tools used to treat audio and video and the improvement in technological infrastructures.

Mobile telephones: have brought educational content and services closer to users.

Educational games: have considerable educational potential.

Augmented reality: in widespread use in such fields as medicine, engineering, archaeology, etc. Its greatest contribution is the creation of 3D realities and spaces using abstract data that make it possible to accurately reproduce real spaces in digital format.

Context-Aware: environments and devices developed to respond to voice, movements or any other type of subtle signal made by the occupants of a context.

All this technology is present not only in educational spaces but also in daily life. The fact that is integrated into daily life for decision making, communication and access to information means that young people feel comfortable in a technological environment. This is what the university should use to generate other spaces for learning. These spaces in face-to-face universities can lead to blended learning projects that take full advantage not only of our experience in face-to-face projects but also the potential of IT (Dziuban et al., 2004).

3. CONCLUSIONS

Some of the advantages of including activities in 3D settings over traditional teaching are the following:

1. The learning curve of the 3D platform is short and effective.
2. They are efficient resources for online teaching because they motivate students to participate.
3. They improve communication and interaction among the course participants, both teachers and students.
4. This technology needs to be taken into account as an innovation in the media used to support the process of teaching and learning.
5. In the creation of three-dimensional virtual worlds, technology must be used to give rise to immersive and fun teaching and learning spaces that are attractive to participants and conducive to the fulfilment of the learning objective.
6. In order to develop a teaching and learning environment in a 3D virtual world, there must be an interdisciplinary team consisting of graphic designers, thematic experts, instructional designers, technological consultants and programmers.
7. It is important for the design not to contain many distractions because the main aim of the world is to be used in the field of education.
8. Virtual simulations in 3D facilitate the learning of theoretical processes and abilities and professional skills.
9. The use of 3D environments favours the creation of collaborative pedagogical strategies that generate communicative and innovative alternatives for students.

The use of advanced technological environments for education is a challenge that represents a qualitative leap forward in the field of teaching. This challenge can be divided into two parts: firstly, changes can be made to some elements that are the driving force behind the transition to a student-centred educational model; and, secondly, there is a need to overcome the idea that teaching is little more than the individual action of the teacher who focuses on controlling the classroom and the specific content of the subject.

In a recent report published by New Media Consortium and EDUCAUSE Learning Initiative, Johnson et al. (2010) show that the central themes in education will continue to be closely linked to IT issues. Some of these are clearly related to digital contents and electronic books (e-books), and 3D simulations and environments.

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