Teaching 3D Arts Using Game Engines for Engineering and Architecture

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Abstract. The main objective of this paper is to evaluate the application of 3D virtual worlds for teaching different subjects mainly oriented to architectural visualization and creating 3D models for multimedia. The use of 3D technologies, multi-user virtual environments and avatars are new methodologies for the student to have a much richer experience and therefore more motivating for a deeper understanding of the assessment and help understand more collaborative the projects. In this paper we work on the concept e-learning and blended learning technologies related to interactive 3D spaces such as OpenSim, Activeworlds, Secondlife, Unity and others. The students' participation in these virtual 3D environments will help to understand the concept of an architectural project and 3D creation, improving collaboration between students and teacher, and dramatically increase in a greater understanding of the project and a high degree of their involvement with design develop. The paper describes the method of teaching 3D arts using Game Engines like Unity.

Keywords: Virtual reality, Game engines, Visual learning.

1 Introduction

Although many educators have created outstanding learning environments, the belief persists that the classroom is the domain of PowerPoint presentations and similar tools. This is a non-effective use of electronic capabilities in education. Meanwhile, creating more effective learning environments using virtual environments is a highly intensive labor. The learning curve is steep for both student and educator.

It is necessary to evaluate the degree of satisfaction, need [1], and interest that the use of these technologies can provide, both in the training of the student and their perception of the technology [2][3]. In this paper, we present a proposal for appropriate use of technology, specifically the implementation of Virtual Reality (VR) with a classroom-based video game Engine.

Nowadays, 3D technology and multimedia must assist education in activating all senses in order to improve student learning [4][5]. Concretely, we propose the enhancement of learning with 3D material, from the application to the Multimedia Engineering Grade and Architecture. Our proposal represents mixed learning and blended learning [6], usable with both face-to-face and virtual classes.

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The applied learning methodology means learning by doing [7], as well as the use of applied gamification techniques. The purpose of learning is to create a collaborative project [8][9]. The main objective for ideal blended learning is the use of interactive methods with technology such as Unity or Opensim, plus gamification for engaging students and achieving better learning outcomes.

Our hypothesis is that the use of 3D virtual environments, video game engines, or multi-verse environments will be one of the challenges in the future of education [10][11]. This challenge is due in part to the high degree of interaction and collaboration between all the stakeholders.

To enact this experiment, we will use videogame engines, which we shuffle Unreal (UDK) and Unity because of their portability with mobile devices and tablets, their high graphical quality, and their multiplatform nature. Also we will experiment with multi-verse virtual worlds where the social aspect will take on particular relevance. That is, virtual worlds such as Second Life or Open SIM will be important to other learning-system developers who are more interested in the social aspect of virtual education.

In this paper, we present a new way of teaching using the modeling, texturing, and illuminating capabilities of 3D. This represents a new way of delivering practical exercises that substantially involve the student. The purpose is to maintain and increment the motivation or engagement in different ways. In the 3D technology references in this article we propose to create a greater experience and interaction from and for the student, in the name of greater global learning.

The experiment improves how a 3D model is presented. The traditional method is composed of presentation classes in which deliveries of 3D model are made by students who have to create a determinate 2D model. After this first step the student send to the teacher some static images of the model. This kind of exercises is strictly procedural, in that the student demonstrates that he or she knows how to use the tools for the 3D model and then render the result. However, the implication curve is low because the student looks for a result that may more or less overpass the minimum and doesn't go further in his/her skills with 3D tools.

Also in the experiment, we add an improvement to the model visualization. The presentation implies a greater knowledge for videogames and real-time engines. At the same time, we look for a greater interaction and collaboration among students and teachers. To involve more implies a pupil with greater motivation. And a greater motivation makes the student propose greater and more disciplined goals.

2 3D Modeling Innovation in Ways to Learn

In this new way of presenting and learning 3D modeling, two technologies are used: the first one, it is proposed that the delivery of models be online, where the 3D model can be uploaded and visualized on the web. In this case, the methodology will be 3Dclever so that 3D models will be directly uploaded on the web in a simple and effective way. The web allows the visualization and interaction with the object on a web navigator (such as Firefox or Chrome) with HTML5 support. This type of

presentation is useful for directly visualizing the model and evaluating it independently of the modeling tool used. Moreover, is possible to visualize in various hardware formats: personal computer, laptop or tablet.

To follow the evolution of the creation of a concrete model is better than a drawing. A 3D model allows for more student involvement and more interactivity.

The second proposed is use a game engine called Unity for an enhanced interactive and user experience.

To exemplify the last methodology proposed, we shall proceed to explain a real exercise applied in a Multimedia degree on the subject of "Computer Animation" at La Salle, Ramon Llull University, a six-ECTS-credit course that is taught annually. This course has a total of 62 students.

3 Implementation of the Proposal

The objects represent a model creation that includes a geographic area inhabited with roads, wheels, a water tower, etc. [Fig. 1]. Also depicted is a typical house and structures that could be banks, saloons, food shops, police headquarters, etc. [Fig. 2]

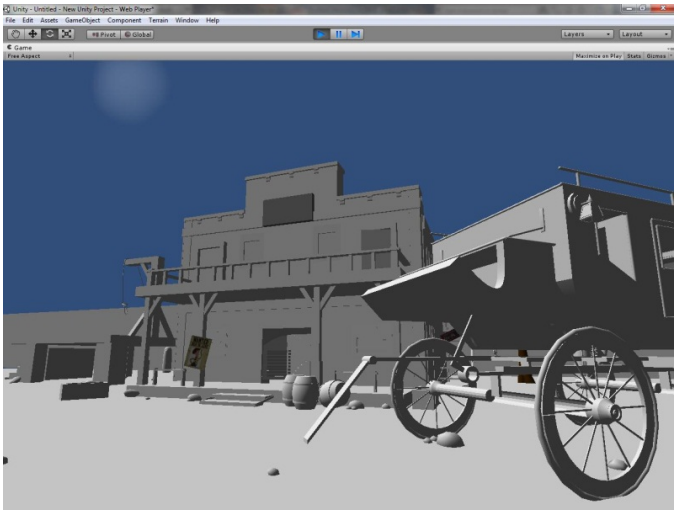

Fig. 1. 3D model of a caravan and saloon in Unity

The implementation that is proposed is a graphic-quality motor in which students' models can be easily incorporated in a virtual world using web navigation in mobile devices and personal computers. Students would be able to interact and visit the models virtually [12]. Also, to potentiate the collaboration among all the class, we propose not only to create independent models but to create a far-west town using the input of all the students, along with teacher supervision. This project would call upon greater collaboration and interactivity.

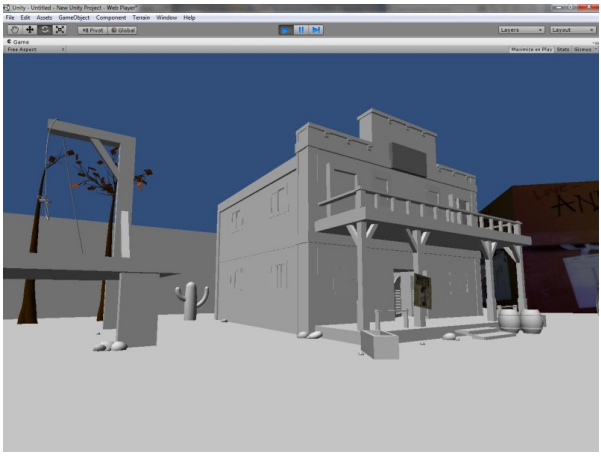

Fig. 2. 3D model of a gallow and a saloon in Unity

So, once all the models are presented, the teacher will introduce the models in the engine and from a tablet on the web. All the students will be able to use and "play" in the streets of the city created by themselves, visiting the shops of their peers' creations [Fig. 3]. The term "play" will have a certain importance in this method, because even the use of videogames is fun, it is also educational.

Fig. 3. 3D textured model of a saloon and caravan

To create a bit of competition and attempt to be cool to peers and the rest of the class, the engagement part of the motivation process improves notably. These processes, applied in the gamification, are taken into consideration when executing the process of this methodology of 3D impartation [13].

To evaluate correctly the progress and determine if the objectives in the hypothesis represent an improvement in student involvement and greater learning due to the increment in motivation, we will proceed to distribute two surveys, at the beginning of the experiment to obtain the student's profile "see Fig. 4" [14] and at the end of the experiment to evaluate the user experience "see Fig. 5" [15]. With these types of surveys we obtained a subjective motivation, efficiency and satisfaction that the student has perceived using this new methodology, and basic data about the elements to improve.

NEW TECHNOLOGIES				
How much interest do you have for the computers and technological advances in general?				
Nothing	Little	Something	Quite	Much
What technologies are you using from the list below?				
Mobile	Cam	MP3-MP4	Computer	
Ladtop	Console	Smartphone	Tablet	
Do you have any of these technologies? Indicates which:				
How many hours a day do you use the computer?				
<1	1-2	2-4	4-8	>8
You use the computer to:				
Estudy	Work	Leisure	Other	
INTERNET, SOCIAL NETWORK AND OTHER TOOLS				
Which device you use to connect to Internet?				
Mobile	Ladtop	PC	Smartph.	Tablet
How many hours a day you connect to Internet? (regardless of the device)				
<1	1-2	2-4	4-8	>8
Where you usually connect to Internet?				
Home	Univ.	Work	Ciber	
WIFI public	Mobile	Other		
What type of connection you usually use? (regardless of the device)				
WI-FI	ADSL	3G	TV	Other
Which services from Internet you usually usually use?				
E-mail	Chats	Browser	Games	
Architecture	Blogs	Sports	News	Others
Do you use social networks?				
To what do you use the social network?				
Professional	Estudies	Friendship	Others	

Fig. 4. Extract of the profile test

Profile test incorporates specific question about the technology that students will use to know the degree of knowledge and expectations about its use. Some questions related are:

- Do you know what VR is?
- Do you think that is useful for your studies?
- Do you think that applicating VR would improve your?
- Do you thing that VR will be difficult in its application?
- Do you thing that VR technology can be a limitation for the final?

After completion the experiment, we will define the post-test "Fig. 5". The main purpose of this test is to evaluate student assessments of the course content and the support technology (VR in this case). Through the structured test, based on International Organization of Standardization (ISO) 9241-11, it will be possible to evaluate the feasibility of using VR technology in educational environments while focusing on the usability guidelines of Effectiveness, Efficiency, and Satisfaction.

EFFICIENCY
The use of game engine Unity is robust and stable?
The use of game engine Unity is easy and fast for create a 3D environment?
The interface of Unity is clear and intuitive?
The interaction of the 3D world is more interactive than other tools that you known?
SATISFACTION
The quality of the 3D content models has a good definition?
The models created for the engine are difficult to achieve the minimun polygon resolution?
Is the Virtual Reality useful for 3D learning process?
Is the Virtual Reality good enough for 3D content creation?
The use of Virtual reality of the instructor is useful?
LEARNING
What is your perception of the interactive use of the Unity?
Playing with the virtual world has a improvement for understanding 3D space?
What is your perception of the utility of Unity for 3D creation?
What is your perception of the interactivity of the use of 3D worls with the professor?
What is your perception of the interactivity of the use of 3D worls with the other students?
Playing with the virtual world created with Unity is a collaborative way of learning 3D content?
What is your perception of the use of Virtual reality engine is more engaging that other 3D tools?
What is your perception of the self interactivity for use Unity engine?

Fig. 5. Usability post test

In the experimentation and investigation of the scientific hypothesis that serves as the basis of the study, a correctly designed and used "user test" will be created to allow the extraction of data to study.

In the teaching field, the typology of any test used has as a principal objective to value the usability of any new processes of the training project. This focus means that the kind of questions must be oriented to the teaching methodology and not the project itself, so that the project evaluation is realized with specific questionnaires relative to same. So that depending on the function of the training method and the obtained results, it will be possible to validate the initial hypothesis and to review a more effective implementation of how teaching methods can be incorporated into the new technologies favorably.

Surveys are designed to model the answer of the implementation of a technology or kinds of technologies. In the university, teaching resources depend on the user profile, highlighting those that are focused on measuring the effectiveness and efficiency of the course, as well as the opinion and degree of satisfaction and pupils' preferences.

The survey will be a questionnaire that will be presented to the participants in paper format. The questions of efficacy and efficiency have been created using a Likert scale. Each question will be assigned a numerical value. The value assigned will indicate the degree of accordance or disagreement with the question one a five-point scale, so that the questionnaire is answered with accuracy in terms of the degree of accordance over the affirmations.

The Likert scale is the most-used scale in investigations where each option is valued and the answers of each person are summed to obtain a unique punctuation of a theme [15]. Consisting of a set of items presented according to affirmations or prejudices in which reactions are sought from the participants, who choose one of the five criteria indicated by the following table "Table 1".

Table 1. Likert scale

Value	Equivalence
1	Strongly disagree
2	Disagree
3	Fine
4	Agree
5	Totally agree

Technically it is chosen the Unity engine to create a virtual world for:

- Notable graphic quality.
- Upgrade plug-in architecture.
- Free except exportation to IOS and android.
- Easy scenario creation without having to program. Fast implementation.
- Is possible to export to multi-platform web and mobile devices such as android and IOS even if an expense is involved.
- Multi-player future possibility (with the smartphone plug-in, for example) so that all the class can be at the same time in the virtual town, creating a game.

The possibility exists that, once implemented, the multi-player becomes interdisciplinary. This would allow for programming and videogames by the students, adding interactivity, actors, and even mini-games within the town. For example, if a student has created a bank, in the videogame subject they may implement a banking game. Therefore all students apart from visualizing the models created in an interactive world, also will use them for executing their own routines of programming and videogames. Creation is interactive, and 100% unique. The models must have certain minimum model conditions so that unity will work.

4 Future Lines

It is also been experienced that the possibility exists to create multi-diverse worlds for avatars and to interact in the virtual world. As in second life, the alternative that it is being shuffled is OpenSim.

OpenSim adds respect to Unity including databases, avatars, positioning a house in a town inside a global world, server scripts, etc. In other words, a persistent world that is open to everyone. OpenSim is making headway as a viable alternative to Second Life. About 98% of the functionality of Second Life is present in OpenSim. The remaining 2% primarily deals with vehicle physics.

For avatar creation, existing plug-ins as EVOLVER where one can make their own avatars can be used in OpenSim and Unity where they can also be implemented in the multi-player world.

Unity and OpenSim have the potential to be engaging, interactive ways to deliver educational experiences to students. They are more productive, because they include students rather than solely relying on teachers to create content.

5 Conclusions

In this paper we have reviewed and conceptualized the research of teaching 3D arts with virtual reality technologies in a university setting, always considering the model sample selection and type of analysis.

The methodology designed will begin deployment in the academic year 2012-2013, beginning in the second half when results will be obtained in the course of "Computer Animation" at La Salle, Ramon Llull University.

In the first qualitative samples taken, it has been observed that the proposed survey design is consistent and allows analysis without any problems. It seeks to implement technology in teaching through the study of the user profile of students. The survey has been implemented with the support of digital Moodle Intranet, allowing fast and accurate results.

The expected results for students are that their academic progress will be faster and more satisfying through the use of a virtual reality environment.

This technology applies learning 3D virtual creation, 3D modeling, 3D animation, and creating spaces for architecture, which should lead to a paradigm shift in the presentation, visualization, and understanding of media and architectural projects.

For these reasons we can say that we are in front of teacher and students' great improvement of how learn 3D arts for multimedia and architecture with virtual reality, because it pushes for collaboration among students and further achievement levels for learning 3D.

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