A High School Educational Platform based on Virtual Worlds

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Abstract

Virtual Worlds, through their three-dimensional or two-dimensional graphical environments, have become a very popular kind of software application that has been used in different fields, from games to simulation or education. They allow individuals to interact with others through their avatars and with objects in the environment. Virtual Worlds provide new education opportunities where collaboration and cooperation among users can be easily achieved. This paper presents an innovative educational approach that can be applied to different educational areas, and levels, from basic to higher. Initially it has been oriented to teach computer science to high-school students. The paper analyses how the current virtual world platforms should be modified so that they can be used in education. It also describes the main issues and problems that need to be solved in order to develop an operative educational platform for undergraduate students. Finally, a usability evaluation study of several existing technologies (3D virtual world platforms, development programming environments, etc.) performed by several (high school) students is presented.

1. Introduction

Although Virtual Worlds (VW) have been used in different domains such as Economy (Sinrod, 2007), Social or E-Commerce (Talbot, 2008), the most popular are related to massively-multiplayer online games1. However, VWs can be used as a new powerful instrument for instruction and education allowing social interactions, which can be a basis for collaborative education. The attractive 3D graphical environments provided by these VW can be used to improve interaction and a sense of realism.

Different initiatives aimed at applying VW to learning, or educational, processes exist. For example, the work of (Baker, Wentz, & Woods, 2009) shows how psychology instructors can use Second Life as a meeting space with students, and to create labs, buildings, and objects that can be used to learn psychology contents and skills. (Cunha, Raposo, & Fuks, 2008) use Second Life as an environment for collaborative learning and generating of new educational contents. The creation of an environment and a location for collaborative learning in Second Life was the focus of the work of (De Lucia, Francese, Passero, & Tortora, 2008), in which objects have been modeled and programmed to support the synchronous role-based collaborative activities required by the jigsaw learning technique in a 3D virtual meeting setting. In the specific context of teaching technical subjects, Second Life has been used with medical and health librarians and educators (Boulos, Hetherington, & Wheeler, 2007), in order to explore the pedagogical potentials of Second Life as well as some issues and challenges related to the use of virtual worlds. The recent work of (Bourke, 2009) analyzes how multiple remote participants can engage in 3D geometry within a virtual environment.

This paper presents an innovative educational platform, named VLEAF (Virtual LEArning platForm),

1 http://en.wikipedia.org/wiki/List_of_MMOGs
which has been designed to stimulate interest and learning ability of students through the use of technologies that are familiar and particularly attractive to them. It also facilitates the implementation of collaborative (students sharing knowledge on a particular topic) and cooperative (students perform a task or solve all together a common problem) teaching techniques. By using the VLEAF platform, the learning model goes from one in which students have an almost passive role (apart from a minimal interaction) and learns on their own, to one where students play the leading role in the learning environment and work with other students and teachers in the creation of knowledge that can be shared with others. Our approach uses a particular Virtual World, named OpenSim that has been recently developed by IBM and is compatible with Second Life, as the base element to implement the new educational platform. The initial goal of this work is to develop a teaching community where students can acquire basic skills related to computer programming. For this reason, an introductory programming course oriented to high school students is designed to analyze how VWs could be adapted and what other elements, such as web portals, documentation or multimedia support are needed to provide the necessary access to both educators and students.

![Fig 1. VLEAF platform](image)

**2. An educational platform based on VW**

When teenagers want to use this kind of domains there are some resources that need to be provided. The VLEAF platform is composed of the following elements:

- Web portal that allows: fast access to any documentation; student management (two different roles: administrator and educators); access to multimedia information

...
- Data Bases that are used to store: technical and user guides; educational documentation (courses guides, multimedia, etc.); teacher and student profiles; student educational material; Data mining information (logs, conversations, student and educator interaction in the VW, ...)

- Other software programs: data mining and statistical software

- VW grid, that provides: physical spaces where the lecture or laboratory can take place; physical spaces to store the educational objects created by teachers and students.

Fig. 1 shows a graphical representation of the platform. The Web portal\(^2\) provides educators or students access to technical and educational material.

The VLEAF platform has been built on a grid over OpenSim, based on our previous experience in Second Life (SL), this new grid has been designed to allow restricted access educational spaces for high school institutions. Our first campus\(^3\), still available at SL and deployed past 2008, is located at the European University, an SL island where there are currently about 20 universities.

OpenSim provides an open fully compatible with SL simulation 3D environment that solves the previously mentioned problems. We can define as much space as we need for educators (it is free, so there is no cost associated to the educational task), the information can be stored in locally owned servers, so that it can be analyzed later by educators, and the control over all this world is in the educator hands.

3. A basic programming course in VLEAF

Although some important elements of our platform are still under construction (especially those related to the automatic restricted access for high school students), both virtual worlds (at SL and OpenSim) are enough deployed to allow controlled experiments. This section provides a simple case study to test some of the functionalities of our platform. We have designed a programming course to show how a scripting language (the Linden Scripting Language) works. This course has been tested with several high school students, to find out what kind of facilities need to be provided for future experiences with other educational institutions, and students. Initially a basic programming course has been designed to evaluate the potential interest of students in learning these basics by using the VW technologies (Heaton, 2008). This course provides the basics about working in the OpenSim VW and about algorithm programming, and it has been designed as follows:

1. (1 h) Introduction to VW: installation, avatar creation, and brief introduction to VW

2. (1 h) Basics of building: basic introduction to building and creating prims and linking them to form objects. Rotation, position, and other more advanced attributes of prims are studied

3. (1h) Introduction to LSL: syntax and basics of the Linden Scripting Language. Compiling and debugging a script in the VW; how to create scripts and perform basic operations; script structure

4. (1h) Data and variables in LSL: basic data types and variables in LSL; programming script examples

5. (1h) Control structures: how to control scripts through variable values, conditional sentences, and the three different loop types available in Second Life

\(^2\) [http://www.ii.uam.es/~dcamacho/vleaf](http://www.ii.uam.es/~dcamacho/vleaf)

\(^3\) [http://www.ii.uam.es/esp/sl/index.html](http://www.ii.uam.es/esp/sl/index.html)
6. (1h) **Strings in LSL**: comparing and parsing strings in LSL; programming script examples
7. (1h) **Objects and Events**: sending instant messages; introduction to event-based programming
8. (1h) **Advanced Data types & Algorithms**: lists in LSL to hold a collection of items; searching and sorting algorithms

For each session several usability parameters have been measured, to analyze how attractive and useful this environment is for learning basic programming concepts. The questionnaire details and the experimental setup and results can be found in section 4.

### 3.1. High-School educational processes in VLEaF

When the potential users of an educational environment similar to the one described in the previous section are teenagers, special care must be taken in order to avoid harassment or any other kind of possible attacks to this kind of users. For this reason, although VLEAF can use our current campus at SecondLife, access to the VLEAF educational platform will only be allowed through our grid at OpenSim. In this grid we can control at any moment the avatars connected and the actions that they could be doing (these actions are saved through the vamp server as data logs). The platform needs to provide the following roles to different users:

- **Administrator.** S/he can control any avatar within the platform (it can only be applied over the grid deployed under OpenSim VW)
- **Educators.** They will have the control over their student team. They will control (through the logs stored related to their students) and can prevent a connection for a particular student or students. They will manage the educational materials (in traditional formats and in the format of educational virtual objects) available through the web portal and the Virtual World.
- **Students.** They can access different educational documents through the web portal, and solve exercises proposed by educators through the Virtual World.

Currently the control over high school students are made by a peer-to-peer process where the administrator of the system provides a set of predefined avatars (including names and passwords) to the responsible educators. Student and Educator interactions in the VW are saved by using the Vamp Server which allows its analysis.

### 4. Usability evaluation of VLEaF platform

This section describes the usability and user satisfaction parameters measured with their related tests, and the practical conclusions achieved. In this evaluation two selected sets of four educators and (high school) students were used to test the platform and to obtain the usability (based on user’s skills), the user satisfaction, and the potential of this platform applied over educational processes.

To obtain the user’s skills, we calculate the sum of the numerical values freely auto-assigned by each user depending on his/her level of competence on the client side issues described in the questionnaire. The usability of VLEAF was measured by means of a popular standard test called “Practical Heuristics for Usability Evaluation” (Perlman, 1997). This test includes 13 questions ranging from 1 (bad) to 5 (good), which provides a useful measure of the user’s perceived usability. The results of this test are shown in left part of Fig. 2. This figure shows that three types of users can be identified: those with basic skills (range 0-20), medium (20-40), and advanced (greater than 40). The first two groups are associated to students, divided in basic and advanced. The third group is associated to teachers, with higher experience and skills. The figure shows high usability values
for the whole range of participants, although as one might expect, the most skilled users assign slightly lower usability values. A possible explanation is that skilled users are more demanding, and these results in slightly lower evaluations, but even these advanced users provide high usability values. The standard deviation in each range is low for basic students (0.2) and teachers (0.3), denoting a uniform knowledge, but increases for advanced students (0.5). This denotes slightly variations in usability for this range of users, but within reasonable values.

![Usability and User Satisfaction](image)

Fig. 2. Left: Usability of VLeaF for different user skills. Right: User’s satisfaction on the user interface as a function of the user skills.

The user’s satisfaction concerning the VLEAF user interface, was measured by means of a slightly modified version of the standard test “User Interface Satisfaction” (Chin, Diehl, & Norman, 1988). The standard version includes 27 questions, but it was reduced to 25 due to overlaps with the usability test described previously. Valid responses to these questions were positive integers ranging from 0 (not satisfied at all) to 7 (completely satisfied). It must be noted the different scale value compared to usability range. The results, showing the dependency between the user’s satisfaction and his/her skills are shown in the right part of Fig. 2. The average value for user satisfaction was 5.5, and it is worth noting that the user satisfaction depends on the user skills in the same way that usability, that is, higher-skilled users assign a slightly lower value to satisfaction. Three ranges can be identified as it was for usability (the first two for basic and advanced students, and the third one for teachers), and the behavior of the standard deviation for each range follows the same that usability, that is, small deviations for basic students (0.4) and teachers (0.3), and bigger (0.7) deviations for advanced students.

From experimental results we can conclude that VLEAF provides good average values for usability and user satisfaction concerning the user interface for a wide range of user competencies, what confirms that VLEAF is a highly usable platform for users in a wide range of skills, from non initiated ones (students) to advanced ones (teachers).

**5. Conclusions**

According to the report on the implementation and use of ICT in schools for primary and secondary education (year 2005-2006) under the Plan Avanza⁴, the 71% of Spanish teachers never use a computer to support explanations at their lectures, and 82.2% do not use ICT for presentations or simulations, although the 94.6% stated to have access to computers at their school, and many of them admit that ICTs have a great educational potential. These data

⁴ [http://www.oei.es/tic/TICCD.pdf](http://www.oei.es/tic/TICCD.pdf)
demonstrate that new resources are not generally used in primary and secondary education. The reason could be related to the need of an operative infrastructure and tools, services and contents to facilitate their lectures.

The use of the proposed platform would solve this problem as it allows educational resources developed by individual students or teachers to be used by others. From our initial empirical evaluation, we have observed that the Virtual World provides a very attractive domain where students discover that learning can be an interesting experience. Although there exist a huge amount of information in Internet related to Virtual Worlds (such as Second Life or OpenSim) or to programming, there is no specific documentation oriented to high-school students. Finally, the proposed programming course (based on a simple introduction to C-style scripting languages such as LSL) is definitively more interesting than the traditional ones.

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References


