Teaching computer science using *Second Life* as a learning environment

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Immersive education using the popular *Second Life* virtual environment is becoming significantly common. Many institutions and education organisations have already set up a virtual campus and are already conducting virtual lessons in Second Life. However, most of the courses currently being delivered are still limited to non-technical subjects or related to Linden scripting. This paper shares the processes and lessons learned from a pilot project exploring the use of Second Life as a learning environment for computer science subjects. This paper describes the experiences of preparing and delivering Second Life materials in the classroom. It provides a student and lecturer perspective of the advantages and disadvantages of conducting lessons through virtual worlds.

Keywords: virtual environments, immersive education, Second Life

Introduction to immersive education

Immersive education is a novel learning platform that can combine interactive graphics, commercial game and simulation technology, virtual reality, voice chat (Voice over IP/VoIP) and rich digital media with collaborative online course environments and classrooms (De Freitas 2006). Immersive education gives participants a sense of "being there" even when attending a class or training session in person is not possible, practical, or desirable (Ebner 2005). There are many claims found in the literature for the usefulness of immersive environments in encouraging the learning process. It is asserted that the use of such environments can stimulate the enjoyment, motivation, and engagement of users, aiding recall and information retrieval, and can also encourage the development of various social and cognitive skills (Betz 1995 and Mitchell 2004). Many such environments have been identified with Second Life (SL) being one of the more popular. Second Life is a completely user-generated 3D environment that comes with building and scripting tools. This makes SL a potentially viable learning environment in which to engage students.

Learning and Second Life overview

There has been some research done on the viability of virtual environments, similar to Second Life, upon the teaching and learning process. Dickey (2005) concluded that immersive worlds can have a significant impact on the experiential learning process. In addition, Antonacci and Modaress (2005) identified the educational possibilities of using environments such as Second Life. In Second Life many subjects have been adopted in one form or another as part of the teaching and learning process. Some of these subjects are in the areas of arts, sciences, and health education (Skiba 2007). However, there has not been sufficient work done on Second Life with “information technology” or “computer science” related subjects.

Background

Temasek Polytechnic is a tertiary institution with 15 years of experience in conducting information technology related diplomas. The students in these diplomas are primarily from an Asian background with a good exposure to information technology usage during their secondary school years. Two subjects related to computer science and game development were chosen to adopt Second Life on a trial basis, namely introduction to computer games and data structures and algorithms. Both subjects are delivered in a span of fourteen (14) weeks. Each subject consists of multiple tutorial and/or practical groups, each of which is twenty-two (22) students, on average, in size. Introduction to computer games is a first year core gaming subject that introduces students to the different aspects of games and game development. Data structures and algorithms is a second year core programming subject taught using the C# programming language.

Introduction to computer games

Rationale

The teaching team intends to use Second Life as a tool to introduce serious gaming and it's potential. All students enrolling in introduction to computer games have no prior knowledge with the SL environment. The primary learning outcome of using SL is to allow the student to discover the potential of immersive 3D environments in the areas of education, commerce, and marketing.

Preparation

During the preparation period the teaching team spent three (3) weeks exploring SL with the intention of finding suitable sites. The teaching team began by trying to create a list of all potential education and commercial activities currently available in Second Life. This task was made all the more difficult not only by the frequency by which sites are added to and removed from SL, but also by the number of sites related to organisations exploring the potential of SL not being open to the public. Eventually, the teaching team adopted a straightforward search, using SL's in-world search engine, for all locations self-identifying as a "museum", "shopping", or "marketing". Eventually the teaching team produced a list of more than hundred (100) interesting sites. The teaching team next visited each of these sites 'in person' and assessed each of them according to the following three criteria: (1) the nature of the site, (2) the type of exhibits displayed, and (3) the special features available for visitors. Resources and descriptions about these sites available on the internet were also consulted. Then the teaching team selected the sites most suitable for the designated learning outcomes. For education the international spaceflight museum site was selected. For the commercial domain the design for digital media lab, chez prim and proper, and lassard marina were selected. For the marketing domain IBM, Reuters, Sun Microsystems, and BMW were selected.

Delivery

During the delivery period, students were informed about the activities one week in advance. Students were required to form groups of four to five and create their own SL accounts for the activities. Members within the same group must have the same last name to aid the lecturer in identifying the grouping of each student. Students were encouraged to orient themselves before they started the activities, as there is a certain learning curve that the student must master. Virtual note cards were distributed to the students on the day of their activities. Each group was required to go through the three different domains but in different sequences. This sequencing was done so as to prevent over-crowding. At each site, the students were given a virtual note card that clearly stated their objectives and questions related to the site that they needed to respond to. Each group read the instructions on the note card and attempted to find the answer to these questions on the site that they were visiting. The questions were either related to the objectives of each site or to the main landmark or facilities on the site. The students then created their own virtual note cards with their solutions and dropped them into a designated location before they proceeded to the next site.

Data structures and algorithms

Rationale

Traditionally data structures and algorithms is a challenging course with a heavier emphasis on programming in the laboratory. Students often find difficulty coping with the subject and give up midway through the semester. As such, the team teaching chose to adopt Second Life as a potential learning environment with the intention of better engaging the students in this subject.

Preparation

The preparation period could be broken down into three phases. During phase one the primary activity was the exploration of SL to identify existing sites that could be used for data structures and algorithms. However, since no suitable in-world sites were found, the teaching team decided to build their own learning activities around the subject content. During phase two the teaching team spent one (1) month learning the underlying Linden script language used by SL. During phase three the teaching team identified a preliminary set of topics that could be used to generate appropriate Second Life learning activities. These included loops, arrays, abstract data types, and linked lists. The goal was to generate two (2) weeks worth of learning activities. The learning activities were 2D in nature. The teaching team

decided to focus on 2D learning activities, rather than the 3D learning activities initially, because they wanted to build up their expertise of Linden script as quickly as possible without getting distracted by the 3D modeling aspect of Second Life. The intention was to allow students to use the learning activity with minimal intervention from the tutor. Thus, each of the 2D learning activities had note-cards with specific instructions and feedback messages to indicate the outcome. For each learning activity messages and Linden script's state system were utilised to enable students to communicate with the activity and for the activity to function properly. One example of a learning activity related to loops and arrays is shown in Figure 1.

Figure 1: Loops and arrays learning activity

In this learning activity students are provided with an array that is represented by a group of cubes. Two red buttons on the left-hand side control panel are provided to run the simulation and observe the cubes change color based on a certain pattern. On the right-hand side control panel the students are provided with a set of green buttons each of which displays a code segment using arrays and loops. The objective is for the students to correctly match the code segment to the simulations observed. If students select incorrectly, feedback is provided with some hints. If students select correctly, a rewarding message is generated.

Delivery

During the delivery the teaching team decided to use one half of the lab time (i.e. one hour), to allow students to use Second Life. A thirty-minute orientation session was for provided for each student group, after which students were assigned to work on the learning activities. One of the challenges faced was to identify the quantity of learning activities to develop since one learning activity per student was considered impractical due to the development time. It was decided to allow groups of students to work on the learning activities in a round-robin fashion. Each learning activity had an object that dispensed instructions via a note-card. During the session the tutor's role became more of a facilitator. Once a student finished, completion was tracked by sending the data out of SL via http to an external site.

Methodology

Since the project was a pilot study the methodology used was qualitative in nature. This pilot study focused upon the tutor and student populations for both subjects at the polytechnic. The sample size consisted of two (2) tutors and forty (40) students. The tutors were selected by the subject team leaders and the students were selected using simple random sampling. The instruments used for data collection were the tutors' journals, interviews with tutors, and interviews with students. The interviews with both the tutors and students were conducted at the end of the delivery phase of the project.

Results

The results of both subjects can be categorised into two areas: the student perspective and the teaching team's perspective. The results related to the students were collected based on the teaching team's observations and students' feedback. The keys results are (1) an increased level of student engagement, (2) evidence of peer teaching amongst the student avatars within SL, (3) note-cards being observed as an ineffective medium to provide instructions, (4) incorrect student expectations of SL, and (5) learning activities perceived as a good form of practice by the students. The results related to the teaching team were collected based on feedback sessions with the teaching team during the preparation and delivery of the subject. The key results are (1) SL requires a lot of hardware resources, (2) regular updates of Second

Life client were disruptive to the learning environment, (3) a significant learning curve is required to master Linden script for teaching team, (4) the lack of a suitable SL compiler was problematic during the preparation period, and (5) the role of tutor during delivery became more of a facilitator.

Conclusions and future work

Our experiences and data using Second Life in computer science and gaming subjects suggest that SL could be a viable learning environment. However, further explorations and evaluations will be necessary to evaluate the effectiveness of meeting the learning outcomes. Future work will include expanding the learning activities to replace a tutorial class, identifying ways to streamline the preparation of learning activities, and identifying the impact SL has on learners' different learning styles.

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