Improving Student Creativity with Gamification and Virtual Worlds

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ABSTRACT
Games are of great interest in education. Their motivational qualities make players more persistent and resilient. In particular, virtual environments have proven to be good learning engagers, as they generate opportunities to create, explore and communicate. Here we present an exploratory study on how student autonomy and creativity can be improved by mixing virtual environments and gamification. To attain this, we added to a gamified course a 2.5D virtual environment that grows along with student grading, called AvatarWorld. There, students are represented by customized avatars, and they also can create custom content. Preliminary results suggest that even though students did not spend too much time in AvatarWorld, they were motivated to perform creative tasks that required knowledge acquired in the course.

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Gamification; Education; Creativity; Student Participation; Virtual Worlds

ACM Classification Keywords
H.5.2. User Interfaces: Evaluation/methodology

General Terms
Measurement; Experimentation; Human Factors

INTRODUCTION

Education is an ever-evolving field, constantly adapting and making use of technology to improve learning and content delivery. For example, studies show that learning with videogames may significantly boost student motivation, diligence and performance, on many subjects like math [8], numerical methods [2] and programming [10]. Multi-user virtual environments (MUVEs) have also been of particular interest to education, given their rich interactions among players and objects, virtual embodiment in the form of avatars, the simulation of real world contexts at lower costs, content production capabilities, and the sense of belonging to a community [12]. By creating opportunities to explore, create, and communicate, research suggests that MUVEs might help to improve students' learning outcomes [9, 6].

A recent process called Gamification is also being used to improve student engagement. It comprises using game-elements in non-game contexts [4, 5], to explore people's natural desires for achievement, status, self-expression, and altruism, among others, to motivate and engage them into adopting certain behaviors [3, 14, 13]. Gamification draws on the motivational qualities of good games which, unlike traditional learning techniques, can deliver information on demand and within context [7], and adjust its difficulty according to one's ability. Gamification of education has been used in online services like Khan Academy[1], where students watch online videos and perform exercises to learn about several topics, with progress being tracked with points and badges. Lee Sheldon [11], in turn, showed how a conventional learning experience can be designed as game without using technology, where students are awarded with experience points instead of using traditional grading.

In a previous work we gamified a college course, named Multimedia Content Production (MCP) [1], which included game elements like experience points, levels, a leaderboard, challenges, and badges. Although our approach succeeded in improving student online participation and proactivity, it still restricted their expressiveness and overall engagement. In this paper we present an exploratory study that combines gamification with virtual worlds, and examine its potential benefits over student autonomy and creativity. To our gamified course we added AvatarWorld, a virtual environment that evolves and grows as students are graded. Each student is represented by an avatar that can be customized with clothing and used to explore the virtual world. Students can also produce custom content, like equipment and buildings. After analyzing many aspect of the students' behavior, we found that even though our virtual world failed at engaging users to perform frequent activity over time, AvatarWorld was able to greatly improve student participation in creative tasks.

THE MCP COURSE

MCP is an annual semester-long MSc course in Information Systems and Computer Engineering, at Instituto Superior

Gamification'13, October 2 – 4, 2013, Stratford, ON, Canada.

[1] http://www.khanacademy.org

Figure 1. The MCP course leaderboard.

Técnico. The course follows a blended learning setup where students attend live theoretical lectures and laboratory classes, but also engage in discussion and complete assignments in a Moodle[2] virtual learning environment. The lectures introduce multimedia concepts like capture, editing and production techniques, multimedia standards, copyright and digital rights management. In the lab classes, there are periodic assignments, and various tools and concepts are introduced on image, audio and video.

MCP is a gamified course that includes game elements like experience points (XP), levels, a leaderboard, challenges and badges. Course evaluation consists of regular quizzes, a multimedia presentation, lab classes, a final exam, and a set of collectible badges. XP and badges are awarded to students for performing course activities, like attending classes, finding related resources and finding bugs in support materials. Challenges model course activities into meaningful time-limited tasks, which reward them with XP and badges. Students start with 0 XP and progress into new levels for each 1000 XP they receive, with the maximum level being the 20th. Thus, each level is directly translated to a final score in our traditional 20-point grading system, i.e., a student with 2000 XP would be at level 2, which means her current grade would be 2 so far. The entry point for the gamified experience is the leaderboard, publically available on the course forums (see Figure 1). Here, students are shown by descending order of XP, with each row depicting their photo, name, XP, level and collected badges. By clicking a row, the player's achievement history is shown.

In our previous experiment we compared several measures of student behavior between a non-gamified and a gamified version of the course [1], with the latter showing significant improvements in terms of online participation and proactivity. A survey revealed that students found the gamified course to require more work, but to be more interesting and motivating. However, students stated that game illusion could be greatly improved by providing students with more autonomy and opportunities to be creative, and by including elements like avatars and items. Thus, student feedback led us to believe that our gamified learning experience was still too restrictive, and that students needed to feel more in control.

Figure 2. AvatarWorld.

Figure 3. Shopkeeper interaction in AvatarWorld.

AVATARWORLD

In a new experiment, we integrated a new component with the gamified MCP course, named AvatarWorld. It consists of a *Pixel Art*[3] 2.5D virtual world that evolves and grows with the students (see Figure 2). The world starts as a small village but as students are awarded with XP, it expands and new characters, buildings and areas emerge. Students are represented by an avatar that can be used to explore the world. Its equipment can be customized with clothing and handheld objects, which students can unlock by achieving certain course badges. Students can also create custom content for the game, like buildings and equipment, using tools and techniques taught in class. Submissions were made via posts on Moodle and were then graded by faculty, based on their creativity and technical correctness; those with scores of 50% or above were accepted into the world. Students could get at most 600 XP (3% of maximum grade) from these contributions and receive two badges.

AvatarWorld was made with HTML5, Javascript and PHP, and it ran asynchronously. A link was available from the course forums, and every time a user logged in, other players' avatars were loaded into the world and placed where they were previously left, but were then controlled by artificial intelligence. While most non-player characters (NPCs) told stories and jokes when interacted with,

[2] http://www.moodle.org

[3] http://en.wikipedia.org/wiki/Pixel_art

shopkeepers NPCs displayed items available to be equipped (see Figure 3). Students could also leave public messages in their avatar's message queue, which would be sequentially displayed every time another player interacted with it.

AvatarWorld aimed to create opportunities for students to be autonomous and creative. We wanted to engage them by providing a new way to assess their progress and by improving their sense of online identity and reputation [3]. Owing to its early stage, activities (or quests) to do inside AvatarWorld were lacking. Hence, there was not much to do in AvatarWorld besides creating custom content, reading stories from non-player characters and exploring the map.

PRELIMINARY STUDY AND DISCUSSION

We deployed a preliminary version of AvatarWorld during the academic year of 2012-2013, which lasted for 19 weeks. We had 54 students, of which four were exchange students, and most of them had finished their undergraduate computer science degree on the previous year. To assess how students subject to gamified learning would be affected by a virtual world, we collected data regarding student activity on Moodle and AvatarWorld, and gathered student feedback via a satisfaction survey by the end of the term.

AvatarWorld Activity

The number of webpage loads of AvatarWorld made by students, from their web browsers, reached 410 in the first week, which gradually fell in the following six weeks and stabilized in the average of 10 loads per week from then on (see Figure 4). In-game operations, like equipping objects, walking around, and creating messages followed a similar pattern. In the first week we saw a total of 4000 equipment operations, which gradually dropped in the following four weeks and then stabilized in the weekly average of 53 operations. Of the last six weeks, four had zero equipment operations. Similarly, students moved their avatars a total of 17481 times during the first week, which progressively fell in the next five weeks, steadying in the average 430 move operations per week. The number of message operations per week was the smaller observed. The first week had 86 operations, but it rapidly fell to an average of 0.67 operations per week, with 10 weeks having zero operations.

Results show a clear hype during the first weeks, but soon students grew tired of AvatarWord. Thus, their activity suggests what we already expected: AvatarWorld failed to engage students into performing regular activity, which might reflect a small contribution to the course's overall engagement. This is confirmed by student feedback, with AvatarWorld being rated as the least engaging of all game components in the course. Moreover, students affirmed that the lack of anything else to do, besides creating custom content, rendered the experience dull. There were not enough meaningful actions to do in AvatarWorld, and even the ability to equip and unlock equipment items could not help it. However, we did expect the messaging system to help keeping students entertained for a while, but it seems

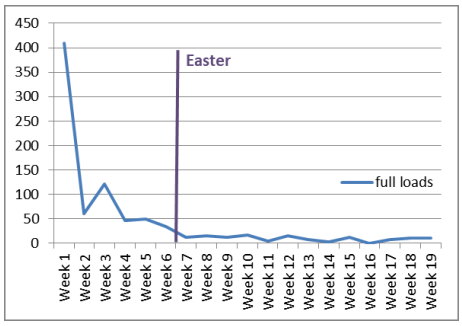

Figure 4. Weekly number of AvatarWorld webpage loads.

to have been the least engaging part. Students reported to be missing the ability to specify the message recipient which, added to the lack of interesting things to do in the world, might have rendered the messaging system redundant.

Moodle Activity

Students were able to submit custom content via Moodle posts, on dedicated threads. Of the 54 students, 13 made 60 new buildings, of which 47 were accepted into the game, and 19 students created a remarkable 172 new equipment objects, all of them included in AvatarWorld. These are high participation results, given the considerable effort and time required to create new objects and buildings, as reported by students, and that they could not get more than 600 XP from crafting custom content. We had so many equipment contributions that soon the unlockable content became irrelevant. Students made far more creative and diverse objects in the first weeks than the faculty staff could have ever created in a whole semester. While it spoiled the motivational effect of the unlock system, this unexpected twist of events is the reflex of the huge potential of this approach to engage students in performing creative tasks.

There was a notable discrepancy between the contributions of equipment objects and those of buildings, and we suspect there are two main reasons behind this. Firstly, the equipment objects allowed students to customize and distinguish their avatars, while buildings had no major connections to their creators. Secondly, buildings were harder to create than equipment, owing to their larger size. The way contributions occurred over the term seems to support this theory. While equipment contributions over time followed a pattern somewhat similar to that observed

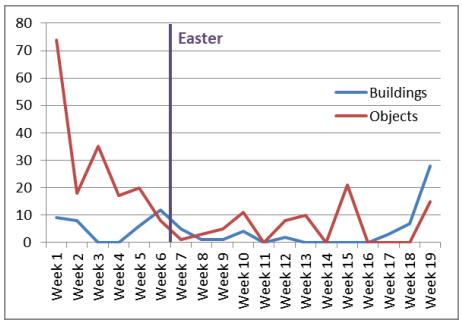

Figure 5. Weekly number of student contributions.

in AvatarWorld's activity, i.e., a great hype during the first weeks, with small activity spikes from then on, building contributions followed an inverse pattern (see Figure 5). There were few contributions most of the time, with some activity spikes; however, there was an activity boom by the end of the course, with 38 contributions (44%) occurring during the last three weeks. This suggests that, because buildings were less appealing to create, students saved them for last, as an ultimate resource to get extra XP.

Our data suggests that contributions came from students with disparate profiles. From the 19 students that made equipment contributions, 9 were in the top 10, but 4 were in the second half of the leaderboard, one of which was a top contributor. This suggests that AvatarWorld could possibly be used to reach many types of students, some of which would not be otherwise engaged.

Student Engagement Limitations

AvatarWorld seems to have succeeded in motivating students to perform complex creative tasks that required knowledge acquired in the course. Because it is still in an early stage, AvatarWorld lacks the ability to engage users in many aspects. As suggested by students, AvatarWorld should be integrated with the course's challenges, or even have its own quests, to make it more interesting and meaningful. This could further motivate students to visit AvatarWorld often and put in practice learned concepts.

The world's growth over time reflects the evolution of the class, but there is no way to assess one's own progress. This could be fixed by creating forms of individual progress display, such as one's house growing as a reflex of the grades. There should also be a stronger connection between custom content and the creator, to improve their sense of identity and emotional attachment to the experience.

Although students were only able to create custom contents regarding image processing, this approach could easily be extended to cover other multimedia formats, such as audio and video, which could further improve learning outcomes.

CONCLUSION AND FUTURE WORK

We introduced a new approach where a 2.5D pixel art virtual environment, called AvatarWorld, was added to a gamified course to improve student engagement. Preliminary results suggest that AvatarWorld succeeded in motivating users to perform complex creative tasks, but failed to actually engage them with the course. Future work includes a formal engagement evaluation and improving AvatarWorld's engagement, by adding quests, portraying individual progress, and improving player notoriety.

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