The Design and Use of Educational Games in 3D Virtual Worlds

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Abstract: 3D Virtual Worlds have gained popularity in the resent years. The use of 3D VLEs has also extended the variation in the distance and online education. Another concept that sweeps the current educational practices is gamification. To converge both concepts Istanbul University has created its own virtual campus on a 3D VLE, and has been creating applications and games for foreign language and mathematics education. In this study, those applications and games will be presented and discussed. The designing phase, application of those games with learners, the experience with the learners, and the results of this process will be evaluated. The examples are 1) "Machinima Project" to equip foreign language teachers with digital literacy and "Language Park" to teach Turkish learners Italian, 2) "Coordinate System Robot" game to teach 7th grade learners the coordinate system, and 3) "Snow Dogs" game to teach 5th grade learners the fractions in their Maths class.

Introduction

3D Virtual Worlds have gained popularity in the resent years. The use of 3D virtual learning environments has also extended the variation in the online and distance education. Another remarkable concept that influences the current educational practices is Gamification. Games have been influential in creating relaxing and motivational context that facilitate learning. Playing with educational content scaffolds learners to construct knowledge, enables better retention of knowledge, creates the necessary social environment for learning, and helps in application of that knowledge in novel situations. Thus, using educational games that are designed in 3D virtual learning environments with learners in various levels and educational contexts is also gaining prominence.

The 3-D virtual learning environments (VLE) could be classified as an application of computer assisted language learning (CALL). To Kluge and Riley, (2008) these VLEs are regarded as multi-user virtual environments (MUVE) or Metaverse. The Horizon Report of 2007 forecasts that 3-D environments will have '*strong potential for teaching and learning', and that developments in open sources and standards will bring 3-D MUVEs 'closer to the mainstream education year by year'* (EDUCAUSE, 2007) The 3-D VLEs are developed, constructed, owned and changed by the "*content and objects that are created by the learner*" (Keskitalo et al., 2011; Salmon 2009). Learners as avatars have the freedom to design the learning environment itself. They can design and construct the environment in collaboration by determining scenarios, own what they create and construct the knowledge by free will.

As a 3-D virtual learning environment Second Life facilitates distance education, collaborative learning, constructivist learning, learning outside the classroom, autonomous learning and etc. in the context of learning. In addition, by providing learners with the freedom to choose the learning materials it makes learners create and design in the learning process, thus

develop ownership on the process and environment of learning. Moreover, SL environment enables learners to immerse and practice in the target culture autonomously (Levy, 2009), raises the motivation of learners through technology use (Chang, 2005; Ushioda, 2011).

Creating games for users of such environments is another aspect that this study works to find out. The term Gamification is taking over in the education field as well. Designing games for such 3D virtual worlds is actually extending the possible uses of those virtual environments. Through educational games or game-like applications these virtual worlds could be exploited much better by learners and by educators. Given the interest of the students towards games in real life, this aspect could be transferred into education through these new environments. Game designers are working very hard to employ principles to engage and keep the children on games, the very principles could be used by educators for engaging and keeping learners on learning. In this context, Gee (2003) states that "*Education researchers are now seeking to understand these principles, so that they can understand how to make education more effective*". Jahnson et al. (2005) persist that "*there is increasing interest in serious games, programs that obey solid game design principles but whose purpose is other than to entertain, e.g., to educate or train*"

Games or game-like applications that were created in 3D environments could enable learners to immerse in play individually or together in collaboration. The contexts in which 3D games could be used varies according to the need and interest of the learners. For instance, vocabulary games or game-like games like role plays with avatars could be used for foreign language learning. Rankin et al. (2006) support that "*game play experiences foster learning in the virtual world as players accomplish game tasks*". Other educational games could be designed and used for learners with other specific areas like mathematics or science education.

The Study

Istanbul University has created its own 3D virtual campus on a 3D VLE, and has been creating applications and educational games for foreign language learning and mathematics education. In this study, those applications and games will be presented and discussed. The designing phase, application of those games with learners, the experience with the learners, and the results of this process will be evaluated. The examples are (1) "Machinima Project" to equip foreign language teachers with digital literacy, and "Language Park" to teach Turkish learners Italian language, (2) "Coordinate System Robot" game to teach 7th grade learners the coordinate system in their Math class, and (3) "Snow Dogs" game to teach 5th grade learners the fractions in their Math class.

Findings

Istanbul University research team has worked towards creation of 3D environment which later could be used for educational activities. For this purpose, the three of the Istanbul University symbols in real life; the gate, the Rectorate building and the Fire Tower were designed in 3D. After the successful transfer of these objects into the Second Life platform, the 3D Virtual Campus of Istanbul University was created. Some original and more modern buildings were added to this campus for educational activities. These include a conference hall, classrooms and activity buildings.

Moving pictures, sound and stories are becoming one of the most powerful ways of communicating learning content in the digital age. The virtual campus has provided the

environment for creation of new educational activities in higher education of this kind. The first activity that came out of the environment is the "Machinima Project" that aimed at equipping foreign language teachers with digital literacy. In their Drama class in 2014, 80 pre-service language teachers were given the task to create their own machinima on 3D VLE (virtual campus) and prepare a lesson plan through which they could use their machinima in real life classes. Machinima is a neologism deriving from machine and cinema and refers to the use of real-time 3D computer graphics to create and record cinematic productions. The actors in machinima are avatars (managed by pre-service teachers) and the environments they inhabit typically belong to a virtual world such as Second Life. Machinima can be used to simulate real-world interaction and dialogues in realistic 3D environments (Can & Simsek, 2014).
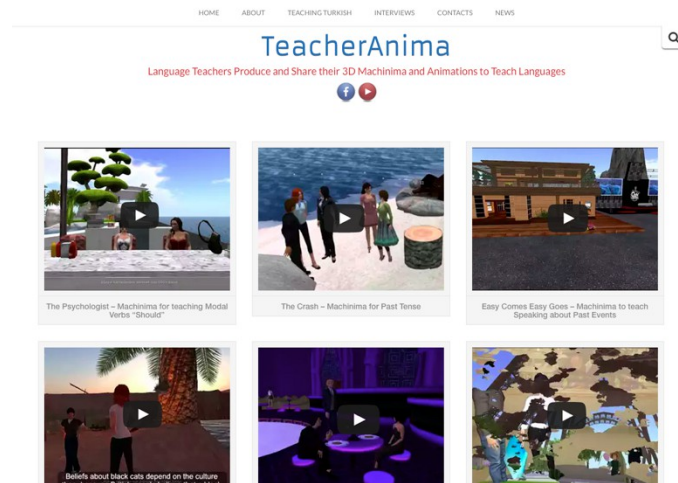

Figure 1. A Scene of TeacherAnima (http://www.teacheranima.com)

Another game-like activity in the context of foreign language learning came out as a result of teaching Italian to Turkish learners. The small project was named "Language Park" where a platform was specifically developed for language learning through gamification and in particular to the learning and exchange of Italian language. Through gaming activities, International (Turkish – Italian) tandem exchanges, role plays in virtual settings (holodeck), web quests and "walking and talking" virtual tours were organized. This has given us the opportunity to creatively rethink and experiment with a different and informal idea of Italian Language Education.

Figure 2. Language Park in Second Life

Second activity area is Math education in primary and secondary education. For this aim, a mathematic robot was created. The function of this game was to enable primary education seventh grade students to see the 3D objects in mathematics courses in a concrete way, to access the information outside the school and to learn the coordinate system by interacting with objects in 3D environments. The robot gave them the task and provided scaffolding through the game. (Simsek, & Deniz2015)

In accordance with the experiment, Wilcoxon signed rank test results, as to whether the answers taken from the Mathematics Attitude Scale which is applied before and after the training with the Mathematics Games developed in SL environment show a significant difference or not, are given in Table 1.

Second Life Education After-Before	n	Mean Rank	Sum of Ranks	z	p
Negative Ranks	18	10.92	196.50		
Positive Ranks	3	11.50	34.50		
Ties	7			-2.951	.003
Total	28				

*Base of negative ranks

Table 1. Wilcoxon Signed Rank Test Results of Pre & Post Mathematics Attitude Test Scores

According to the results shown in Table 1, the difference between the answers given to the the questions in attitude scale before and after the SL learning application indicates .05 significance level (z=2.95, p<.05).

Mean rank in Table 1 shows that the scores of the answers given after the application are higher. In other words the difference is in favor of positive rank, namely in favor of post test score. This result can be interpreted as Mathematics Games that is developed in SL environment, has a positive effect on Mathematics attitudes of SL learning group (Deniz, 2015).
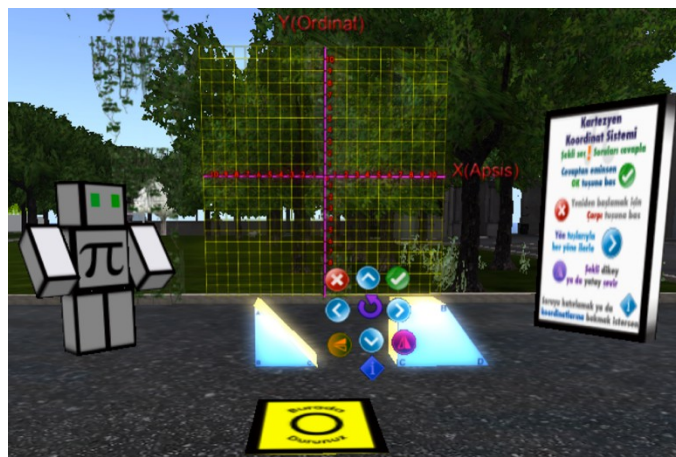

Figure 3. Mathematic Robot Game in Second Life

The third game that has been designed for mathematical education is the "Snow Dogs". This game follows the constructivist principles where the learning content is attached to a concrete concept. Snow Dogs and their positioning is crucial for the sleigh to slide. The purpose of this game is to investigate how 5th grade students' ability of ordering fractions is improved by

using virtual learning environment. Fractions are notoriously difficult for students to learn and for teachers to teach. Most of the students in elementary school have lack of understanding in comparing fractions and fraction operations.

Figure 4. Snow Dog Game in Second Life

Conclusion

Many educational institutions are investing in 3D Virtual Worlds as they have gained popularity in the resent years. The use of 3D virtual learning environments is also extending the variation in education. In addition to 3D VW another concept that influences the current educational practices is Gamification. Games have been influential in creating relaxing and motivational context that facilitate learning. Playing with educational content scaffolds learners to construct knowledge, enables better retention of knowledge, creates the necessary social environment for learning, and helps in application of that knowledge in novel situations. Thus, using educational games that are designed in 3D virtual learning environments with learners in various levels and educational contexts is also gaining prominence.

Istanbul University also contributes to the Turkish educational field by creating its own 3D virtual campus on a 3D VLE, the Second Life. This has provided a fruitful environment for learners to be able to play with the learning content through online applications and educational games for foreign language learning and mathematics education. The examples are (1) "Machinima Project" to equip foreign language teachers with digital literacy, and "Language Park" to teach Turkish learners Italian as a foreign language, (2) "Coordinate System Robot" game to teach 7th grade learners the coordinate system in a game through constructivist principles, and (3) "Snow Dogs" game to teach 5th grade learners the fractions in their Math class. In our experience, the students find SL acitivities more intetresting and different compared to the acitivities in the classroom. Furthermore having an independent environment outside the school and encouraging them to ask questions to each other, sharing more things enable social learning by increasing student interaction. And these results also support the researches of Salmon et al. (2010). These results show similarities with the results of Koenraad (2008) indicating that participators consider the courses more intetresting and different compared to the routine courses.

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Acknowledgements