Designing and Deploying 3D Collaborative Games in Education

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ABSTRACT

This paper focuses on methodologies of serious games deployment and evaluation. Particularly, this study will present a specific category of serious games that are based on Collaborative Virtual Environments and they aim to support Collaborative Learning. We call these serious games Collaborative Virtual Educational Games (CVEG). The paper aims to analyze the deployment and evaluation process, through the study of relevant bibliography, and by doing so to reveal the existing research gap, which fails to evaluate the threefold nature – game, collaboration, and software - of CVEG. The proposed framework aims to support the design, deployment, and evaluation of a CVEG, by incorporating two consecutive and recurrent cycles, each consisting of distinct phases. Furthermore, each phase is designed to address specific goals. Finally, the paper presents four case studies, applying the proposed theoretical methodology for designing, deploying and evaluating a pragmatic CVEG.

KEYWORDS

3D Collaborative Games, Collaborative Virtual Environments, Design Framework, Evaluation Framework, Game Based Learning

INTRODUCTION

Several studies have proven that games can be used as a means of engagement during the educational process (Prensky, 2003; Virvou, Katsionis, & Manos, 2005; Annetta, Minogue, Holmes, & Cheng, 2009). In particular, Game Based Learning (GBL) can be more efficient than traditional teaching methods alone for a variety of scientific areas including software engineering (Navarro & Hoek, 2007), languages (Neville, Shelton, & McInnis, 2009), algebra (Kebritchi, Hirumi, & Bai, 2010), physics (Carr & Bossomaier, 2011), geography (Virvou, Katsionis, & Manos, 2005), health education (Amory, 2010), history (Watson, Mong, & Harris, 2011), and others.

The effectiveness of games in the learning process lies in the motivation and competition between students (Garris, Ahlers, & Driskell, 2002). Motivation can be divided into two types, intrinsic and extrinsic. During a learning activity intrinsic motivation refers to motivation driven by enjoyment for the task itself whereas extrinsic motivation refers to the performance of the student in order to attain an outcome (Ryan & Deci, 2000). Malone (1981) proposed that the primary factors that make an activity intrinsically motivating are challenge, curiosity, and fantasy. A well-structured game activity should incorporate all of the factors that make it intrinsically motivating. The players are immersed in a state of flow (Csikszentmihalyi, 1990) and they are willing to learn in spite of the challenges that they face. However, motivation on its own cannot promote acquisition of knowledge. There is research which calls into question the efficacy of games in the learning process (Girard, Ecalle, &
Magnan, 2013) and according to Hays (2005) GBL cannot guarantee positive learning outcomes in every situation.

Concerning the modality and the e-learning theory, it seems that Collaborative Virtual Environments (CVE) and Collaborative Learning (CL) could support the educational process. A Collaborative Virtual Environment (CVE) is a computer-based distributed VE or set of places. In such places, people can meet and interact with others, with agents, or with virtual objects (Churchill, Snowdon, & Munro, 2001). CVEs are powerful and engaging collaborative environments for e-learning, because they are capable of supporting several important learning objectives (Chee & Hooi, 2002). Furthermore, according to Tsiatsos, Andreas, and Pomportis (2010) the combination of collaborative e-learning and CVEs (i.e., CEVEs) seems to be an effective solution for supporting Computer Supported Collaborative Learning (CSCL) processes.

According to Tsai, Yu, and Hsiao (2012), the direct determinant of performance on knowledge acquisition in GBL, could be if a student simultaneously possesses: (a) motivation to acquire new knowledge in the game; (b) learning ability to successfully understand new knowledge in the game; and (c) playing skill to successfully complete the game’s task. Except for the student’s characteristics, a great factor that influences the effectiveness of a game activity is its design, implementation and evaluation (Sandford, Ulicsak, Faser, & Rudd, 2006). A recent study of del Blanco et al. (2012) proved that a framework for the integration of games in the learning flow is necessary. Moreover, there are only a few attempts for the introduction of frameworks that can support tutors to evaluate games that can be most effective in their particular learning context including their specific subject areas (de Freitas & Oliver, 2006).

Taking into account the above mentioned situation, it becomes apparent that the educator needs an assistance framework, in order to deploy and evaluate collaborative educational games in three-dimensional (3D) CEVEs. The procedure of creating and evaluating a game based activity from scratch should not burden the educator. The establishment and use of best practices is essential to lay the groundwork for an activity that will bring positive learning outcomes. The purpose of this study is to introduce a framework for designing, implementing and evaluating 3D collaborative games in education. The realization of this purpose focused on the creation of a prototype framework through the utilization of some steps from previous frameworks but mainly through the empirical evidence extracted from the conduction of case studies. The aim of these case studies was to facilitate the development of the framework and evaluate whether the framework contributed successfully in creating a usable and attractive game by assessing the game itself. The first case study was conducted during the first cycle of the proposed framework and evaluated the usability of the first version of the game. Therefore, the research question, which addressed from the first case study, was formed as follows:

- **R1**: How the participants judged the usability of the game resulted from the first cycle of the proposed framework?

The other case studies were conducted during the second cycle of the framework and they evaluated whether the use of the framework resulted in a game that is well-functioning, satisfying, and free from the presence of usability problems. The research question of these case studies was the following:

- **R2**: What is the overall attitude of the participants towards the game resulted from the second cycle of the proposed framework?

Although the two research questions does not exactly reflect the overall aim of the paper, which is the introduction of a framework for designing, implementing and evaluating 3D collaborative games in education, they do contribute in validating whether the utilization of the framework resulted in a
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