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The effect of competition on learning in games

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ABSTRACT

Today serious games are having an important impact on areas other than entertainment. Studies show that serious games have a potential of creating learning environments to better reach the educational and training goals. The game design characteristics and game elements are need to be explored in detail for increasing the expected benefits of the gaming environments. In this study, the effect of competition, one of the design elements of game environments, on learning is analyzed experimentally. The study is conducted with 142 students. The results of this study show that when a competition environment is created in a serious game, motivation and post-test scores of learners improve significantly. The results of this study are expected to guide the serious game designers for improving the potential benefits of serious games.

1. Introduction

Today serious games, games having purposes other than entertainment, are being used in several areas such as training, education, and health. However, nowadays these games are blamed to be more like drill and practice software than entertaining and engaging game play (van Eck, 2006). In order to improve the benefits of serious games, one needs to understand their design characteristics and control these characteristics according to educational or training purposes as well as the behaviors and expectations of the learner groups. In that sense, serious game design characteristics need to be analyzed carefully and systematically.

Several game characteristics such as uncertainty, challenge, feedback, fantasy, cooperation, and competition have been studied by several researchers (e.g., Malone & Lepper, 1987). Many other characteristics can be added to this list. Understanding each of these elements and their effect on the game-based learning environments may improve the benefits of these games. On the other hand, there has been little empirical research examining the individual game characteristics on learning (Vandercruysse, Vandewaetere, Cornillie, & Clarebout, 2013) and how the games should be designed for facilitating learning (Dondlinger, 2007). In this study, competition, which is classified as a characteristic of a serious game, is explored. An empirical study is conducted to understand the effect of competition on players' learning performance in serious games.

2. Serious game design elements

Based on different design perspectives and characteristics, the level of involvement, concentration, flow, learning, engagement and/or skill improvements through the game play may vary. In the scope of game-play, several design elements such as uncertainty, goals, challenge, feedback, learner control, competition, cooperation, fantasy, interactivity, flexibility, and fairness to have been explored in the literature to improve the benefits of games (Hong et al., 2009; Malone & Lepper, 1987). In our earlier study (Ozcelik, Cagiltay, & Ozcelik, 2013) we have conducted a research to understand the effect of uncertainty on learning in games. According to the results of this study, uncertainty enhances learning and has positive relation with motivation (Ozcelik et al., 2013). Results indicate that as motivation increases, learners tend to devote more time on answering the questions and to have superior accuracy in these questions (Ozcelik et al., 2013).

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Juul (2005) proposes six necessary and sufficient features for games: (i) rules, (ii) variable and quantifiable outcomes, (iii) value assigned to outcomes, (iv) player effort to influence outcomes, (v) player attached to outcomes, and (vi) negotiable consequences of activities. Studies show that in order to guide the player reaching the game objectives, the goals of the game that the player required to reach and the rules of the game that the player should follow need to be provided explicitly (Csikszentmihalyi, 1990; Johnson & Wiles, 2003; Pagulayan, Keeker, Wixon, Romero, & Fuller, 2003) early in the game (Federoff, 2002) such as in the introduction or briefings of the game (Pagulayan et al., 2003). Otherwise, the player may be lost in the game and it may be hard to understand the players' learning performance through the game play (Dempsey, Lucassen, Haynes, & Casey, 1996). Goal directed activities improve the flow experience of the players (Csikszentmihalyi, 1990). Additionally, when tasks have clear goals, there is a possible concentration in a game play (Sweetser & Wyeth, 2005). Besides, feedback is another important characteristic that affects the game play. According to Malone (1981), feedback helps players to understand their performance in the game and to provide information about their success or failure. Studies also report that games should provide an immediate feedback for the player actions (Desurvire, Caplan, & Toth, 2004; Johnson & Wiles, 2003) in an appropriate way (Csikszentmihalyi, 1990) and should reward players on their progress in the game (Federoff, 2002; Pagulayan et al., 2003). Additionally, players should also be informed about their low performance and right directions (Gee, 2004). Researchers also report that challenge is another important element of a game design (Malone, 1981; Malone & Lepper, 1987; Rouse, 2005; Sweetser & Wyeth, 2005). According to the flow theory presented by Csikszentmihalyi (1975), the challenge in a game is closely related to the skills of the player. Hence, the game should be designed by considering the skill levels of the players. Control is another important component of a game which refers to the openness of the system to allow manipulations by the player (Federoff, 2002; Pagulayan et al., 2003; Pavlas, Bedwell, Wooten, Heyne, & Salas, 2009). Control is the degree to which a learner has the power to make changes in the game environment (Pavlas et al., 2009). Similarly, some fantasy elements in the game design could also be considered another group of factors for creating effective games (Cruickshank & Telfer, 1980; Lepper & Cordova, 1992). Fantasy element, when used in serious games, may craft engaging and instructional challenges (Iuppa & Borst, 2007; Lepper & Malone, 1987; Parker & Lepper, 1992).

Researchers report that the game design features through creating interaction between players such as competition and cooperation are critical elements for effective games (Andresen & Ahdell, 2002; Dondlinger, 2007). “Competition is goal-oriented, directed towards achieving one's own goals even though this may have a negative effect on other competitors” (Hong et al., 2009, p. 5). Several different forms of competition such as team competition, competition between user and computer, competition against oneself, chance and time (Vandercruysse et al., 2013) have been defined for computer games. Several benefits of competition in games have been reported in the literature. For instance competition is regarded as a well structured learning activity that has the potential to draw attention and excitement of students (Cheng, Wu, Liao, & Chan, 2009). Competition is considered as a useful technique to motivate individuals to learn (Julian & Perry, 1967; Malone & Lepper, 1987; Nemerow, 1996; Yu, 2000). For instance, van Eck and Dempsey (2002) report that competition may motivate the students extrinsically and as a result students may put more effort on current tasks. Pareto, Haake, Lindström, Sjödén, and Gulz (2012) also argue that competitive activities motive learners to play the game. Similarly, competitions enhance learning and cooperation among students (Battisti, Boato, Carli, & Neri, 2011; Burguillo, 2010). Atanasijevic-Kunc, Logar, Karba, Papic, and Kos (2011) suggest that competition in games stimulate the interest of students and increases the efficiency of the learning process.

On the other hand, there are some concerns on excessive competitive activities which may cause negative influences on learning such as increasing anxiety, impeding performance on tasks, diminishing empowerment and responsibility for learning (Kohn, 1992). According to Shaffer (2006) competition is not an essential game design element. Similarly, Vandercruysse et al. (2013) found that computation is not significantly related to students' learning gains and only partly related to students' motivation.

Hence, the competitive game environments need to be explored in detail to better understand its effect on learning. Accordingly, we experimentally explored competition to examine its effect on learning in games. For this purpose, motivation, post-test scores, accuracy in the game, duration spent on reading statements and providing responses in the game were evaluated as measures in our serious game implementation. A game was developed to teach conceptual database modeling concepts by using entity-relationship (ER) diagrams, which are used for data modeling in relational databases. Two versions of the game were developed. One included competition and the other included no competition. Half of the randomly selected participants were assigned to the competition condition and the other half were assigned to the control condition.

3. Research methodology

3.1. Participants

The participants of this study were 142 undergraduate students (62 female and 80 male) from computer engineering, software engineering, and information systems engineering departments in Atilim University. The range of their age was between 20 and 28 years ($M = 22.58$, $SD = 1.64$).

3.2. Materials

In this study several materials such as prior knowledge test, the game itself and a Turkish version (Acar, 2009) of the instructional materials motivation survey (IMMS) (Keller, 1993) were used. These materials are described in detail below.

3.2.1. Prior knowledge test

A prior knowledge test was administered in order to examine whether the competition and the control group differed in prior knowledge of the database concepts covered in the game, because research studies have shown that prior knowledge of participants may influence their performance in games (e.g., Lee & Chen, 2009). The test includes five statements such as “I know how to read entity-relationship diagrams” in which participants needed to rate subjectively their knowledge on a scale from 1 (associated with “I know very little”) to 5 (associated with “I know very much”). The prior knowledge test score was computed by taking the sum of the given five responses.