A game scale to evaluate educational computer games

Oguz Ak a *

Abstract

In last decades many studies in the literature are trying to identify the effectiveness of computer games in education. However the results of these attempts are controversial. In order to identify the effectiveness of games in education, it is needed to define the quality in the games. In this article the aim is to identify the quality of any educational computer game in terms of three main categories which are enjoyment, learning and usability. In order to evaluate quality in games a scale to evaluate educational computer games is developed which evaluates learning and enjoyment characteristics of educational computer games. The scale will be used by teachers in order to identify the quality of the computer games before applied to students. Moreover, to develop the scale, a game model is also created. The model explains properties of a qualified game in terms of learning, enjoyment and usability. The model includes three parts as input, process and outcome which identified by Garris, Ahler and Driskell (2002). Also the model has the Kolb’s experiential learning cycle (Kolb, 1984) in the process part.

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1. Introduction

The idea of using games for education is very popular in last decades. There are many studies which are evaluating the effectiveness of games in education (e.g., Tüzün, Yılmaz-Soylu, Karakuş, Inal & Kızılkaya, 2009). Although some of these study results are favoring using games in education, some of them are not (Randel, Morris, Wetzel and Whitehill ,1992; Kebritchi, Hirumi, Bai, 2010). Randel et. al. (1992) examined 68 studies between the years 1962-1991. They found that only 27 of them favoring simulations and games while 38 studies show no difference and 3 studies are favoring conventional instructions. Similarly Kebritchi, Hirumi and Bai (2010) reviewed 40 studies and found that only 16 of them are empirical studies. Among them 9 of 16 improve learners’ achievement, 4 of 16 improve learners’ motivation and 5 of 16 studies do not effect either learner’s motivation or achievement. So these studies show that games are not always effective learning tools. The question is here that what aspects of the games make them effective learning tools?

In the literature there are many attempts to identify the constructs of the games which determines the quality of the games (Fang, Chan, Brzezinski and Nair, 2010; Garris, Ahlers and Driskell, 2002; Squires and Preece, 1999; Kiili, 2005; Freitas and Oliver,2006, Fu, Su and Yu, 2009; Malone, 2010; Sherry, Lucas, Greenberg and Lanchan,
2006). These studies include the general aspects of enjoyment (Fang et al., 2010; Garris et al., 2002; Kiili, 2005), learning (Freitas and Oliver, 2006; Squires and Preece, 1999) and usability.

In this study our aim is to create a model by combining previous studies in the literature, and depending on these attempts to create an educational game evaluation scale. The scale will be used by teachers in order to select good games for using in classes. So the role of the scale is to measure the quality of games before the game applied on students. The scale is developed in Turkish form and it includes 51 items under two categories as learning and enjoyment. Item created depending on the literature but validity and reliability studies are not conducted yet.

2. Evaluating Games

In the literature some scientists analyze the quality of games and they create some constructs. These constructs can be categories in three subtitles as enjoyment (fun), usability and learning.

2.1. Fun/Enjoyment

Malone (1980) listed a set of heuristics or guidelines for designers of instructional games which make the game fun. He list three constructs as challenge, fantasy and curiosity. Moreover, Fang et al. (2010) create an instrument in order to measure the enjoyment of computer game play. The survey consists of three constructs as affect, cognition and behavior which are originally proposed by Nabi and Krcmar (2004). Furthermore, Fu et al. (2008) create a scale in order to measure learner’s enjoyment of e-learning games. The scale consists of the dimensions of concentration, goal clarity, feedback, challenge, control (autonomy), immersion, social interaction and knowledge improvement. Finally, Garris, Ahler and Driskell (2010) by depending on the studies in the literature, listed the essential characteristics of games as fantasy, rules/goals, sensory stimuli, challenge, mystery and control.

2.2. Usability

Squires and Preece (1999) in their study aim to evaluate educational software for learning and usability. While they are creating a list of quality factors they use the constructs related to usability as system status visibility, match system/world, user control, consistency, error prevention, recognition, flexibility, aesthetic design, error recovery and help documentation.

2.3. Learning

Squires and Preece (1999) identified both usability and learning elements of games in a two dimensional table. In this study constructs of collaboration and some components of ownership, credibility and complexity can be listed as constructs related to the learning. Moreover Kiili (2004) creates an experiential gaming model which depends on experiential learning theory, flow theory and game design. In this study he stresses the importance of flow, player’s prior knowledge and the balance between educational goals and game play which are related to educational components of computer games.

3. A Model of Computer Education Game

In order to define quality in the educational computer games, we can define a game model which depends on the model of the games in the literature. Garris, Ahler and Driskell (2002) explain a generally accepted Input-Process-Outcome game model. In the ‘input’ part the aim is to design an instructional program that incorporates characteristics of the game. Then in the ‘process’ part, the game cycle is working in three parts as user judgment, user behavior and system feedback. Finally at the ‘outcome’ part of the cycle there are certain outcomes like achievement of the learning objectives (Figure 1).
In the literature, one of the approaches to the learning is Kolb’s experiential learning cycle (Kolb, 1984). According to Kolb (1984), any given learning process includes 4 stages. Firstly, learners start from a familiar or concrete experience, then they construct knowledge reflect on the learning experience. Moreover, they develop abstract concept and they actively test the abstract concept to complete the learning process. Finally, they move to next learning experience. So model consists of four steps as concrete experience, reflective observation, abstract conceptualization and active experimentation.

By depending on these two models we can define a similar but an extended model. The following model includes the structure of Input-Process-Outcome model which is explained by Garris et. al.(2002) and the elements of Kolb’s (1984) Experiential Learning Cycle in the game cycle part. The model includes following issues in the three parts.

**Inputs:** In the model, there are three input items as learning objectives/curriculum, learner needs, and game characteristics. In this part learning objectives/curriculum is the same idea with instructional content in the Input-Process-Outcome model. Learning objectives are the intended learning outcomes and one of the aims of the game, main aim, is to reach these outcomes. Moreover, game characteristics are again the same with the first model. The game characteristics are coming from the literature which is explained in the evaluating games part and by depending on these literature we can list the game characteristics as “feedback, clear goals, context, challenge, curiosity & mystery, competition, diversion, fantasy, arousal and flow”. Finally, according to Freitas and Oliver (2006) games should consider learner’s profiles such as previous knowledge and skills. So a learner should have the required prerequisite knowledge and skills.

**Process:** In the process part there is a learning cycle which consist of Kolb’s(1984) 4 stages as concrete experience, reflective observation, abstract conceptualization and active experimentation. During these stages, the active learning would be realized. Also in this step there is a need of help part for learners. Moreover, collaboration and social interaction are also contributing factors.

**Outcomes:** In the first model there is only learning outcomes as a result of gaming experiences. However in learning process motivation is also a desired outcome. So in our model there are two types of outcomes as achievement and motivation.
4. Scale Development

For developing the scale a literature review is conducted and existing evaluation studies are analyzed. By depending on the constructs of these studies a large list of items are created. Then, the items are categorized under three main categories as enjoyment, usability and learning. These main categories and explanations of associated constructs are listed below. In the first version of the scale there are 51 items. In the final form of the scale number of items may change after expert analyzes and validity and reliability analyzes. The first version of the scale is created in Turkish form because the teachers are generally speaking in Turkish. Because of language difference items do not added to this article. Moreover, because adequate scales are already available in the literature, the scale does not include usability part. Following explains content of the two dimensions of the scale (enjoyment and learning).

4.1. Enjoyment

In order to define fun and enjoyment in learning we can list following constructs;

(1) Challenge; Sherry et al. (2006) found that players enjoy playing video games to push themselves to a higher level of skills or personal accomplishment. Moreover, Fu et al. (2009) says that the challenges that the game off er should fit the players level of skills. So a game should include an adequate challenge level. (2) Curiosity & Mystery; Garris et al. (2002) identified that mystery evokes the curiosity in the individual. Then, they ask for what creates mystery; Berlyne (1960) explains that mystery is a result of the incongruity of information complexity, novelty, surprise and violation of expectations. (3) Clear goals: Fu el. Al. (2009) explained that the tasks in the game should be clearly explained at the beginning. Moreover, Garris et al. (2002) also identified that clear and specific goals trigger good-feedback discrepancies which is so important for increasing the attention and motivation. (4) Social Interaction; Sherry et al. (2006) identified that the social interaction is the main reason of many individuals’ involvement to the games as a child. According to their study many players use video games to interact with friends and learn about the personalities of others. (5) Diversion; Sherry et al. (2006) found that video games are usually used to avoid stress or responsibilities. Players play video games to fill time, relax or escape from stress. (6) Fantasy; According to Sherry et al. (2006) fantasy is the ability to do things in the games that people are not able to do in real life such as flying, driving race cars etc. Similarly Garris et al. (2002) state that games present activities that is separate from real life. (7) Arousal; Sherry et al. (2006) state that arousal is the emotions resulted from games fast actions and high quality graphics. Flow; Kiili (2005) states that games should be designed to generate positive affects in players, and games could be successful when they facilitate flow experience. Flow is a state in which complete absorption or engagement is realized. (Csikszentmihalyi, 1991)

4.2. Learning

If a game is using for educational purposes it should include some specialties. So a qualified instructional computer game should include following factors in terms of learning:

(1) Learner; According to Freitas and Oliver (2006) a game should consider the age and level of learners, as well as specific components of how they learn, including their backgrounds, styles and preferences. (2) Curriculum; Squires and Preece (1999) states that curriculum has 2 important concepts for games which are subject content and teacher customization. Subject content is the intended scope of learning which is defined by curriculum and the teacher customization is the ability of the game to adapt to the specific needs of the students. (3) Feedback; According to Fu et al. (2009) by using feedback users determine the difference between the gap between current stage of knowledge and the knowledge required for ultimate completion of the game’s task. (4) Context; According to Freitas and Oliver (2006), context defines the specific area where the play/learning takes place. Moreover, content can become an enabling factor for learner support, or can provide significant impediments to delivery. (5) Direct experiences; Kiili (2005) identified that promise of educational games is to engage and motivate players by using direct experiences with the game world.
5. Conclusion

By depending on the studies in the literature an educational game design model which consists of learning inputs, game cycle and learning outcomes is developed. Moreover a list of constructs depend on the game evolutions in the literature is categorized under two main items as enjoyment and learning (usability is not included). Our aim is to define a qualified instructional computer game by using these constructs, and to evaluate the quality of any game before using in education by an adequate scale. In order to realize this aim we have created a mage scale to evaluate educational computer games.

The expert analyzes and reliability and validity analyzes of the scale are not conducted yet, but the main structure of the scale is ready.

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