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A Model for the Combination of Game Activities and Learning Activities in Educational Game

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Abstract: The most challenging work in designing and developing educational games is to combine education with entertainment perfectly, of which, the combining of game activities and learning activities is the key. Based on preliminary study on the integration problem of education and entertainment, a model for the combination of game activities and learning activities is proposed. In this model, game activity is manifested by a series of tasks, which are used to unfold storyline, and there are a group of knowledge, skills and props to be presented, learned, practiced, and applied in each task. Then the practice of combining game activity and learning activity in six wonderful educational games are analyzed to verify this model. The limitation of this study is that the model is simple and only six games are analyzed. The effectiveness of the model to guide design and development of educational game will be tested in further studies.
Keywords: Educational game, game activities, learning activities, combining model

1. Introduction

Although more and more educational games have been produced, excellent educational game is still scare (Johnson, Adams, & Haywood, 2011). Essential elements such as challenge, curiosity, control and fantasy in educational game may stimulate learners to engage (Malone & Lepper, 1987), however, in most educational games, there is no inherent correlation between cognitive tasks and game play (Fabricatore, 2000). The common problem of most educational games is that they are usually separated into two parts of gaming and learning materials (Jantke,2006). Although the Games-to-Teach Research Team has summarized some principles to guide the design of educational games as early as in 2003 (The Games-to-Teach Research Team, 2003), there still lacks clear guiding principles for designing effective games based on empirical research (Adams & Clark, 2014).

Some researchers have explored the problem from different aspects. Game genres may influence the effects of the integration of education and entertainment. In an experimental study, Amory, Naicker, Vincent and Adams (1999) found that students prefer 3D adventures and strategies games to shooting game and simulation. Fabricatore (2000) regards that educational game is an activity and learning is a part of gaming, and the process of learning should be embedded in each game activity. The effectiveness of educational game depends on how learning content are combined with the game environment. Habgood, Ainsworth and Benford (2005) thought that the core mechanism to realize this combination is to establish meaningful game activity by providing necessary interaction so as to realize endogenous learning. If the game-play of an educational game is too strong, then it usually deviate students from learning goal. Shelton and Scoresby (2011) suggested to align game activity with educational goal to resolve this problem, and proposed a framework to demonstrate the process of iterative design and development of educational game. In the study of Echeverria, Barrios, Nussbaum, Amestica and Leclerc (2012), game activity is regarded as the central of educational game design and it is formed through the coordination of a series of rules, mechanism and situation. Based on an empirical study, Wu, Chen and Ma (2015) proposed five basic strategies that can effectively promote the combination of education and entertainment in information literacy educational game, i.e.: use adventure game to make the game enjoyable, plot a compelling story to engage students, motivate students with essential game elements, present learning materials with props, and assign players with tasks to be completed with subject knowledge.

From these studies one can find that the combination of game activities and learning activities is the core of the integration of education and game-play. Based on these studies, this paper tries to develop a model to clearly illustrate how to integrate game activities with learning activities.

2. Methods

Based on studies on the problem of combination of education and entertainment, specifically the five strategies proposed by Wu, Chen and Ma (2015), a model is proposed to explain how to combine game

activities and learning activities. Then six wonderful educational games are analyzed to verify this model. These games are designed to learn math, language, healthy eating habit, optics, static electricity and comprehensive knowledge about food respectively.

3. A Model for Combing Game Activity and Learning Activity

In the five basic strategies proposed by Wu, Chen and Ma (2015) to promote the combination of education and entertainment, strategies 1-3 are about game genre, story, and game elements, which are set to enhance game experience for players. Strategies 4 and 5 are specific measures to integrate gaming and learning, one is about how to deliver knowledge in educational games, and the other is about what kind work should be designed for players to do in the process of gaming, or in game activity. According to strategy 5, the work has to be completed with subject knowledge. This means that players must apply subject knowledge to finish the work, and if players do not possess the knowledge at the moment, they may learn it in the process of gaming by trying, and they can also get help from props. This is how game activities are combined with learning activities. This combination of game activity and learning activity can be expressed as a model, as showed in figure 1.

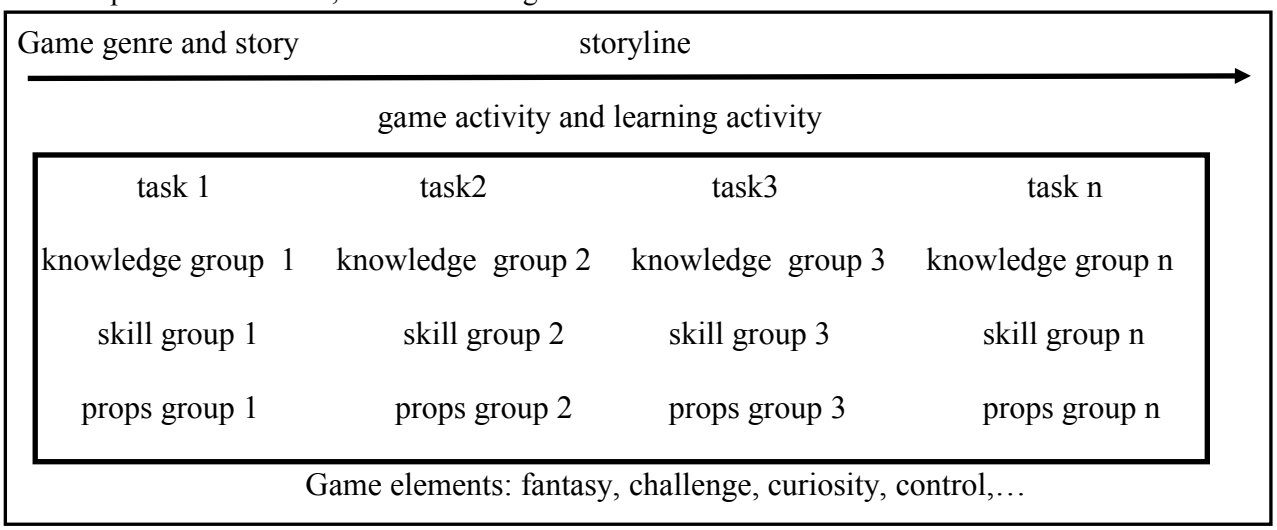

Figure 1. The Combining Model of Game Activity and Learning Activity in Educational Games.

For educational game, game genre and game story are chosen and created according to the attributes of knowledge and skills to be learned, and the essential game elements are embodied both by game story and by game activities. Game activity and learn activity is the core of educational game, as demonstrated in the inner frame of figure 1. Game activity is composed of a series of tasks, and for every task, there are a group of knowledge, skills and props.

4. Case Analysis

Now let's examine how the combination is constructed in six typical educational games.

In *Big Trouble Warehouse* (Creative Knowledge Ltd), dispatch is the core game activity, and students practice calculation and estimation to ship goods of various weight in a warehouse to boats of different load capacity. Tasks are to match boats and goods, then transport goods to boat and send it off.

Basic actions in *Dynamic Cognate* (Dream Host) result in the target action (Echeverria, Barrios, Nussbaum, Amestica & Leclerc, 2012): move bubbles to target words. Typical task in this game is to move bubbles (suffix) to matched words, which is a learning activity.

Game activity in *Squire's Quest!* (Baranowski,2003) is to prepare food and recipes. In the process of finishing tasks such as choosing fruits, juice and vegetables to eat and preparing recipes for knights, players learn food and their nutrition facts and apply the knowledge.

The core game activity in *La Jungla de Optica* is to apply optical knowledge to resolve real problems in the process of rescuing hostage (Squire, 2002). Players are confronted with a series of tasks, such as doing puzzles, building camera and telescope. One optical puzzle is to gather light with lens and focus light to illuminate a dark room, and players can learn and apply focusing principle in it.

At different stages of *Food Force* (iWin Inc), players take different roles such as pilot, appeals officer, nutritionist, logistics officer, and the director of food purchasing. Tasks include: investigating the distribution of people in hungry, preparing and dispatching food, budgeting, farming, planning,

building bridges, and deal with questioning. In this process, players will have to learn and apply various knowledge such as mathematics, geography, food, nutrition, mechanics, finance, communication, etc.

Game activity in *Supercharged!* is to control the movement of charge particles. To do this, players have to learn the attributes of different charges. For example, in the task to move and place charged particles in a maze, players watch and learn the attributes of charged particles (Squire, 2004).

Game activities in these games are all manifested as a series of tasks which have to be completed with professional knowledge and skills. Learning activities are all embed in game activities, as Fabricatore (2000) suggested, and demonstrated by the presented model.

5. Conclusion

This study reviewed current studies on the combination of education and game-play of educational game, and suggested that its core is the integration of game activity and learning activity. Based on the five basic strategies proposed by Wu, Chen and Ma (2015), a model is presented to demonstrate the combination of game activity and learning activity. In this model, game activity is manifested by a series of tasks. Tasks are used to unfold storyline, and for each task, there are a group of knowledge, skills and props to be presented, learned, practiced, and applied. Six educational games are analyzed to prove the correctness and effectiveness of the model.

The model is still simple and only six games are analyzed. The effectiveness of the model for guiding design and development of educational games will be tested in further studies.

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