Identifying Game Design Factor for The Development of Educational Digital Games

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ABSTRACT

Designing and developing educational digital games are complicated processes. In both cases, multidisciplinary teams are required. Moreover, designing a diverse range of educational digital games from start to end can be different in each case. This paper introduces a concise model for designing digital games with an aim to assist and support both educators and game designers. In addition, this model will bridge the gap between educators and game designers, so as to achieve the common goal of developing effective educational digital games. This study intends to investigate and conduct a comprehensive review of the main features and factors for developing educational digital games suitable for different educational contents and platforms. Furthermore, the proposed model is believed to bring benefits to both educators and game designers who are involved in the game design process for digital game-based learning.

Keywords: Educational Game, Game-based learning, Game Design Process, Expert System, Game Factor.

I INTRODUCTION

There were many studies on the impact of games and it has been reported that video games are good for learning (Halverson, Shaffer, Squire, & Steinkuehler, 2006; Prensky, 2004; Rapeepisarn, 2012; Squire, 2008). For the younger generation, it appears that face-to- face learning seems to be less attractive than studying with immersive digital game environments (Carina, 2012; Chang, Hwang, Chen, & Mueller, 2011; Foreman, 2003; Whitton & Moseley, 2012). To facilitate learners' engagement in interactive learning environments from the prospective of learning, digital games can increase learners' motivation and interest (Aldrich, 2003; Rapeepisarn, Pongphankae, Wong, & Fung, 2008; Squire, 2008). These findings have motivated many researchers to investigate how to make educational digital games and how to use them to improve learners' experience.

An effective educational game has been known to offer many advantages and improve the learners' problem solving skills (Gros, 2007; Squire, 2008). Moreover, computer games can serve as virtual worlds, which cultivate peer groups with social competence to share knowledge, skills, and resources (Gee, 2004; Halverson, Shaffer, Squire, & Steinkuehler, 2006; Prensky, 2004; Rapeepisarn, 2012; Squire, 2008). However, it does not guarantee that the use of computer games will bring the said advantages to learners, unless educational content, pedagogy and assessment methods are carefully selected and well integrated into the games themselves.

II MODEL FOR DESIGNING EDUCATIONAL DIGITAL GAMES

This study is initially based on research on current state-of-the-art game designs. A model design based on game design and instructional design approaches has been developed and implemented in this research study. This study aims to provide significant enhancements for placing educational content in games and developing educational games that are appropriate for learners' educational level.

As shown in figure 1, the proposed model is separated into two processes. Each process is described by a number of blocks representing scopes and attributes. The first process is to identify educational digital games by three entities, i.e., levels of education, fields of education, and game platforms. This information is necessary for both educators and game designers. The second one is the mapping process. Input from a collaborative crew of educators and game designers is solicited and afterwards mapped onto its matching elements in 7 aspects. For instance, fields of education will be mapped onto game genres and test/quiz will be mapped onto game quest. The mapping process model was designed to help both educators and

game designers gain a better understanding of the production process in order to develop effective educational digital games that can keep students' learning and engagement at a high level. In this study, investigation and a comprehensive review were carried out in three sections, i.e., identifying the educational digital game by levels of education, fields of education and digital game platforms respectively.

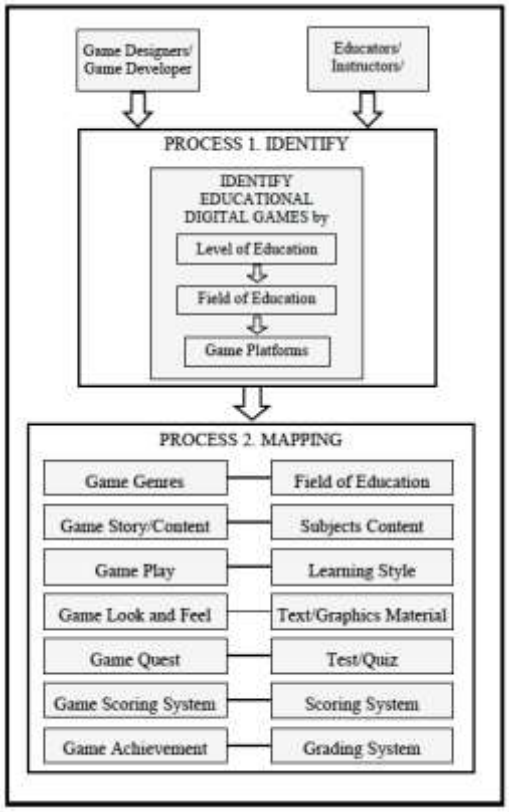

Figure 1. A Model for Designing Educational Digital Games

III IDENTIFY EDUCATIONAL DIGITAL GAMES BY LEVELS OF EDUCATION

The structure of educational system in figure 2 illustrates that educational digital games can be used as supporting tools for learning ("ISCED," n.d.). Levels of education are related to gradations of learning experiences and required competencies of participants. The levels of education in the diagram were arranged for assisting both educators and game designers to recognize the educational digital games before production. The levels of education are referenced from the UNESCO's International Standard Classification of Education. Several studies have already shown that diverse educational digital games were used in different levels of education to assist and support students in learning aspect (Halverson, Shaffer, Squire, & Steinkuehler, 2006; Kiili, 2005; Rapeepisarn, 2012; Squire, 2008). Therefore, it is significant and essential to understand and recognize the levels of education, so that it can assist and facilitate both educators and educational digital game designers to design and develop applications for all levels including special needs schools.

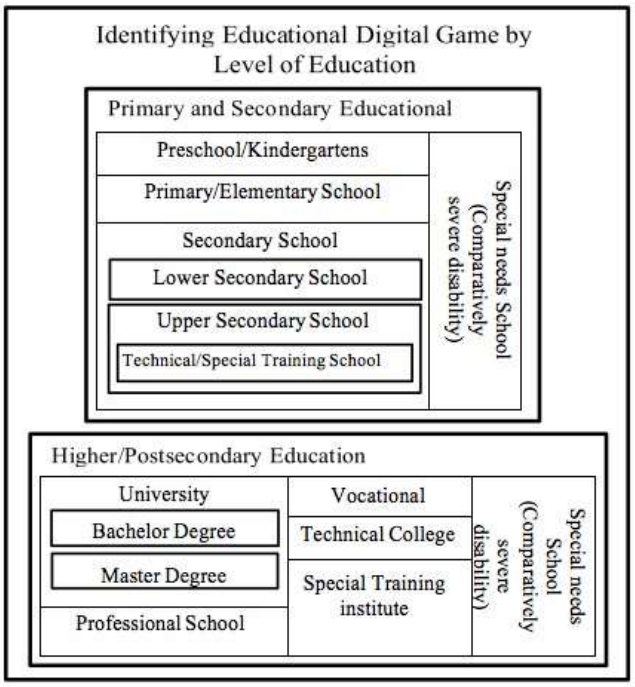

Figure 2. Identifying Educational Digital Games by Levels of Education

IV IDENTIFY EDUCATIONAL DIGITAL GAMES BY FIELDS OF EDUCATION

Identifying educational digital games by fields of study is another basis for design and developing educational digital games. Table 1 shows the selected ten fields of study based on information from the International Standard Classification of Education (ISCED) by UNESCO ("ISCED," n.d.). However, each group can be divided into several subfields. For example, in the fifth group, Science has four groups related to life sciences, physical sciences, mathematics and statistics, and computing. Although it is not shown in the table, in life sciences, there are many subjects in this field such as biology, botany, bacteriology, toxicology, microbiology, zoology, entomology, ornithology, biochemistry and etc.

Table 1. Field Of Education

Fields of Education	
1. General Programs	□ Literacy and numeracy □ Personal development
2. Education	□ Teacher training and Education science
3. Humanities and Arts	□ Arts □ Humanities
4. Social sciences, business and law	□ Social and behavioral science □ Journalism and information □ Business and administration □ Law
5. Natural sciences, mathematics and statistics	□ Life sciences □ Physical sciences □ Mathematics and statistics □ Computing
6.Information and Communication Technologies	□ Computer use □ Database and network design and administration □ Software and applications development and analysis
7. Engineering, Manufacturing and Construction	□ Engineering and engineering trades □ Manufacturing and processing □ Manufacturing and
8. Agriculture	□ Agriculture, forestry and fishery □ Veterinary
9. Health and Welfare	□ Health □ Social services
10. Services	□ Personal services □ Transport services □ Environmental protection □ Security services

The use of educational digital games in each field of educational has reported to be on the rise. However, it should be noted from table 1. that there are some fields of education that cannot be classified into any specific group ("ISCED," n.d.). By understanding and identifying the fields of education will assist both educators and game designers to provide appropriate content suitable for the relevant learning objectives in the pre-production stage.

V IDENTIFY EDUCATIONAL DIGITAL GAMES BY DIGITAL GAME PLATFORMS

A. Non-Portable Platforms

PCs, Game Consoles and custom devices are examples of non-portable game platforms. Educators and game designers can consider which platform to be used. PCs have the benefits of having a wide range of application software available (Rapeepisarn, Pongphankae, Wong, & Fung, 2008). Production of educational digital games on PC platforms can also be supported by a wide variety of input devices. Furthermore, they are more commonly used in most educational institutes. On the other hand, game consoles and custom devices are less commonly used in the educational sector. In addition, the development costs on game consoles and custom devices are higher than the development costs on PCs.

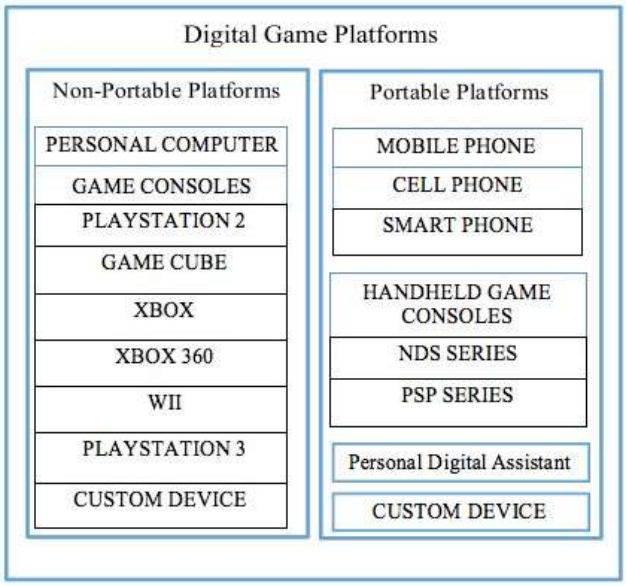

Figure 3. Digital Game Platforms

B. Portable Platforms

Mobile phones, handheld game consoles, and custom devices are examples of portable platforms. They are more popular for educational digital games. Currently, mobile phones, PDAs, handheld game consoles and custom devices are not only just communication or entertainment devices but they are emerging to become an important educational tool. The benefits of portable digital game platforms are that they come in small sizes, are portable, and easy to use and most teenagers are familiar with these devices. Furthermore, they have already been used as learning tools in many schools (Rapeepisarn, 2012; Whitton & Moseley, 2012).

VI METHODOLOGY

In this research study, the data of educational game applications in mobile platforms have been gathered particularly from the Apple App Store and the Google Play Store. 400 educational digital games were specifically selected from popular applications in

educational game category. Initially, 200 educational digital games were picked from the Apple App store while another 200 games ("Educational - App store Downloads on iTunes," 2016) were chosen from the Google Play Store ("Google Play," n.d.). They were then classified again into specific groups in the designed framework. According to the authors' research, the result shows that, there were only 286 out of 400 games from the initial selection that fit well into the constructed models. Game genres including the age range of game players which were between 4 and 12 years old were clearly defined in each selected game. Moreover, it reveals that the role playing game was ranked first among game genres in number of applications. The game content was mainly about arts, linguistics, mathematics, and occupation simulation. Since each game had defined its target audience using player age, they were then mapped onto appropriate levels of education in the designed framework. It was found that most games were designed for players at pre-school and primary school levels.

The model for designing educational digital game was able to assist both game designers and educators in developing games that can accurately target the right audience while the subject content is still appropriate for the learners. Moreover, the number of steps during the project planning and data collection process could be reduced in game development production. Game designers can simply determine appropriate game genres for educators' subjects content and precisely define their target audience. Consequently, game design and development for education can be implemented in the right direction according to the model recommendation.

VII CONCLUSION

It is proposed that a model for production of educational digital games will be beneficial not only for educators and game designers, but also for the digital game industry and education sectors on the whole. Use of educational digital games in the education sectors is already increasing. This study is working in the first phase concerning identification of different levels of education, fields of study, and game platforms. Investigation on the use of educational digital games in other aspects is currently under further exploration and development so as to make the model to be more effective and flexible. During the next phase of this study, the framework is aimed to be further developed to be an expert system providing suggestions to digital game designers and educators in making their games more interesting while still enhancing the learning performance of students. More importantly, the games developed using the proposed model can provide useful feedback for the future improvement of this model.

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