Educational Computer Game Design Model for Malaysian Science and Technology Classroom

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Abstract: - This paper propose an educational computer game design model for Malaysian Science and Technology classroom. The model consist of three aspects of game design which are divided into two core component: Learn and Play. The two core components represent the elements of learning and playing in the educational computer game. Balance integration of both components is essential in developing a good educational computer game. The first aspect of game design is the game elements. Game elements referred to elements that form the base of the educational computer game which are the National Curriculum and also computer as the game design platform. The second aspect of game design is the game environments which comprises of teacher and students. Integration of both instructional (teacher's role) and playing (student's role) elements in the game will form the base of the game environments. The third aspect is the factors that need to be considered by the game designer and education expert in designing effective educational computer game. The model aim to guide educational computer game designer and educational expert in developing educational computer game for Malaysian classroom.

Key-Words: - Educational Computer Game, Science and Technology, Educational Computer Game Design Model

1 Introduction

The Malaysian information and communication technology (ICT) policy in education has been launched by the Deputy Prime Minister, Tan Sri Muhyiddin Yassin on 12th October 2010 [1]. The policy is aim to make ICT's as the main tools in

teaching and learning (T&L) process at schools. According to Muhyiddin "the policy will integrate and manage the available ICT's such as schoolNet, computer labs, EduWebTV and access centre in schools and other future initiatives in order to increase Nation performance" [1]. This is parallel with national education development main plan (Pelan Induk Pembangunan Pendidikan 2006-2010) [2] which aim to produce Malaysian human capital equipped with 21st century skills. The policy's four objectives are (i) continuous human capital development, (ii) integration of ICT's in T&L process, (iii) usage of suitable technology to integrate avalaible ICT initiatives in education and (iv) education management using ICT's.

In line with this, now education researchers are in pursuit of exploring the pedagogical potential of computer games. This is because computer game has become a phenomenon that influences the lifestyle of most of the teenagers around the world [3]. Many scholars believe that educational computer game can motivate and increase student focus in learning and simulate their higher order thinking [3-6].

In the context of Malaysia, a study done by Rubijesmin [7] investigated the experience of students from five schools in Malaysia and he found that 92% of the respondents have experienced playing computer game. The study shows most of the students in Malaysia are no stranger to computer gaming. The implementation of educational computer game in the classroom is seen as rather aberrant though. This is because the educational game industry in Malaysia is still new. As reported by Roslina and Azizah [8] in 2009; "an interview with several educational games developer in Malaysia indicated that the field of education is still relatively new in local scenarios; hence, many localized studies are needed in order to generate more knowledge in educational games in the areas of educational games design, development as well as its effectiveness among our (Malaysian) student" (p.296).

In implementing educational computer game in a classroom there are certain issues that need to be considered especially in term of the education system where the classroom stood in. Malaysian education system is based on the national curriculum which is custom for public school throughout the primary and secondary level. Teachers must teach according to the subject syllabus of a particular designed by the Ministry of Education, therefore every student in public school will learn the same thing. This makes the education system strongly dependant to the national curriculum. Therefore, any intervention of pedagogical innovation in the classroom, in this case integrating an educational computer game, must take into account the necessity to follow the designated prospectus. Here the authors proposed an educational computer game design model specifically for Malaysian classroom.

2 Educational Computer Game

It has been debated that the commercial educational computer games in the market often lack obvious cognitive value due to the emphasized entertainment value in the game [9]. On another hand, there is also case of game that is neither fun nor engaging due to the emphasized educational value of the game [9]. It can be conclude that if the game too fun or entertaining, it lost its educational attribute – student will have fun playing but hardly learning – and if the game is too educational, it will become boring - student will not be motivated to continue playing and apparently will not learn anything. Charsky and Ressler [10] discussed this issue by asserting that (i) "if learning through games is meant to replicate children's more natural style of learning, then making them less like play and more like schoolwork will render them ineffectiveness as educational tools" (p.614) and (ii) "do not dilute the potential effectiveness of games by taking away one distinct attribute that gives them advantage – play" (p.614). According to Nor Azan and Wong [11] "the educational effectiveness strategy (pedagogical element) needs to be integrated as a goal from the start of the design process" (p.269). **Education experts** and **game expert/designer** must work closely together to realize an educational computer game that balances the "Learn" and "Play" component of the game.

3 Designing Educational Computer Game

In 1992, Randel, Morris, Wetzel and Whitehill [12] did a literatures review on 68 researches of educational computer game that were done from 1984 to 1991. In the review Randel, Morris, Wetzel and Whitehill [12] explained that although there are variations in the research result where some (i) favoured traditional instruction over educational games and some (ii) claimed that there are no

differences between traditional instruction and educational games on student performances, but yet Randel, Morris, Wetzel and Whitehill [12] concluded that implementation of educational games in the classroom are consistently perceived as more interesting than traditional instruction. The contradict results (traditional instruction favoured over educational game/no difference between traditional instruction and educational game) were conceivably due to factors such as students gender, students background, game design and teachers competence in implementing the educational computer game as teaching and learning aid.

Jean et al. [13] discussed how different gender reacts differently towards a game and how this affects the student's performances while playing the educational game. According to Jean, et al. [13] "the findings provided evidence that PQ (Phoenix Quest – the game) appealed to girls because the protagonist was of their age and gender, and because the puzzles and searches were engaging throughout the game" (p.207). Another research by Yen, Wang & Chen [14] also elaborated the gender effect on game-based learning to promote intrinsic motivation. According to them, "females tended to be more perceptive than their male classmates regarding motivation, indicating stronger correlation to learning achievements" [14] (p.279).

On the other hand, a research done by Hong and Liu [15] rationalized the effect of student's background and game design towards the overall student's performances while playing the game. According to Hong and Liu [15], students who are considered as experts gamers are doing better compared to novices gamers. Besides, the difficulty and complexity of the game also influenced student's performances [15].

Besides student gender, student background and game design factors, another important factor that needs to be considered in implementing and designing educational computer game in the classroom is the teachers' competence in applying the game in their teaching and learning process. Rubijesmin and Sheard [16] through their research on students social skill while playing computer games in class reported that; "the important issues is not the object or technology used in teaching and learning, but how it is applied and diffused" (p.177) by teachers. This shows the importance of teacher's competence in implementing the educational computer game as teaching and learning aid in the classroom. It is important for the educational computer game to be implemented in the classroom is not bias towards certain groups of students or teachers.

It can be concluded here, that in order to design an educational computer game specifically for Malaysian classroom, there are many factors that need thorough deliberation on part of education expert and game designers in desigining an educational computer game to be implemented in the classroom. On part of education expert, they must take into account (i) teacher's role in the game, (ii) teacher competency and expectation of the game and (iii) how the knowledge delivery will be portrait in the game – this include the pedagogical element. While on part of game expert/designer, they must take into account (i) student's role in the game, (ii) student gender, background and expectation of the game and (iii) how the game play could imply learning – this include the rule, complexicity and background of the game.

Besides the factors discussed above there are other factors that also need to be considered by education expert and game expert/designer while designing an educational computer game. The factors are as follow:

- Infrastructure capability – education expert and game designer must take into considerations the type of game that they intended to create; whether it can be played (i) using the school computer (ii) by many student at the same time (one computer-many players) or individual players (one computer-one player). What is the format of the game? Does it need special requirement (software or hardware) to run it? how will the game be incorporated in teaching and learning process in term of its pedagogical and instructional aspects? Where can the game be played? (classroom, computer lab, science lab etc.)

- School hours - Taking into account the learning time provided for Malaysian schools; between 30-45 minutes per period, it is impracticable to implement a time consuming game in the classroom. Perhaps researchers can design a game which have specific aims "so that learning objectives can typically achieved within 30-45 minutes" [17] (p.255). But, will the game be as complex and challenging for the student to be motivated and engaged?

- Budget - With competition from the state of the art commercial games in the market, usually educational computer game will always lost to the sophistication of the big budget and popular games. In designing and creating an educational computer game from scratch with demand of such higher level of production process are immensely challenging for local researchers and game developers (due to lack of sources, budget, skills etc.).

- Reality vs Virtual - virtual worlds created by educational computer game perhaps can simulate experiences that could benefits student but until what point should virtual world replaced reality? The pro and cons of implementing educational computer game in the classroom needs to be weighed by researchers and game developers in the course of decision making insofar game as instructional medium for the teaching and learning process.

4 Educational Computer Game Design Model for Malaysian Science and Technology Classroom

From the above discussion the authors' proposed an Educational Computer Game Design Model (Fig. 1) which comprehended the issues and challenges in planning and designing an educational computer game for Malaysian classroom.

The Educational Computer Game Design Model consists of three aspects of game design which are divided into two core component: Learn and Play. The two core components represent the elements of learning and playing in the educational computer game. Balance integration of both components is essential in constructing a good educational computer game design. In the planning and designing phase of an educational computer game, the learn component will be monitored by education experts, while the "Play" component will be monitored by game expert/designer. The education expert and game expert/designer will work together in the planning and designing phases of educational computer game, lending their expertise in developing an effective educational computer game for Malaysian classroom.

The first aspect of game design is the game elements. Game elements referred to elements that form the base of the educational computer game. Fig. 1 shows the flow of how decision making is imply at the first stage of educational computer game planning and designing. The stage includes (i) the selection of syllabus and specific topic or learning outcome that will be the main background of the game and (ii) the selection of game design platform, proposition of the type of game (that will also be the background of the game) The aim of the two components of "Learn" and "Play" in the game elements will be to achieve the learning outcome. Game design platform (GDP) is referred to tool or software that will be used to design the educational computer game. There are many game design tool/software available in the market, for example UNITY3D [18] and Game Editor [19]. The game design software will be the platform for game expert/designer, while the national curriculum will be the platform for education expert in planning and designing the game. Beside the decision making process discussed above, there are also others related elements; knowledge, challenge, engagement, and motivation, that need consideration in planning and designing the instructional and playing facets of the educational computer game.

Integration of both instructional and playing elements in the game will form the base of the game environments which comprises of teacher and students. In implementing an educational computer game in a classroom, it is crucial for the game to have distinctive roles for both teacher and student. The teacher is in charge of knowledge delivery of the game, taking role such as mediator, facilitator or even opponent to the students who are the players of the gameplay. It is through the gameplay the student will learn and achieve the learning outcome. With the consideration of the game elements and game environments, the game design aspect is the crucial aspect in planning and designing the educational computer game.

The game design aspect in the model encompassed the factors for consideration in planning and designing the educational computer game. It is necessary for the education expert and game expert/designer to take into account the following factors in order to design an effective educational computer game;

- Pedagogical factor – What is the teaching and learning strategy that will be incorporated in

the game? and, what is the task and/or test that will be used to measure the learning outcome intended?

- Gameplay design factor – What are the game's rules? How complex will the game be? Is the background of the game appropriate with Malaysian classroom?

- Teacher factor – Does the teacher have the skills to implement and integrate the game into the teaching and learning process? Will the game match teacher's expectation in term of the game as a teaching aid?

- Student factor – Will the game be bias towards groups of student with different gender and background? Will the game match student's expectation in term of the game as a learning aid?

- Other factor – Will the available infrastructure able to accommodate the game? How will the gameplay fits into the schools period? How much will the game cost? Until what point should the virtual world in the game replaced reality?

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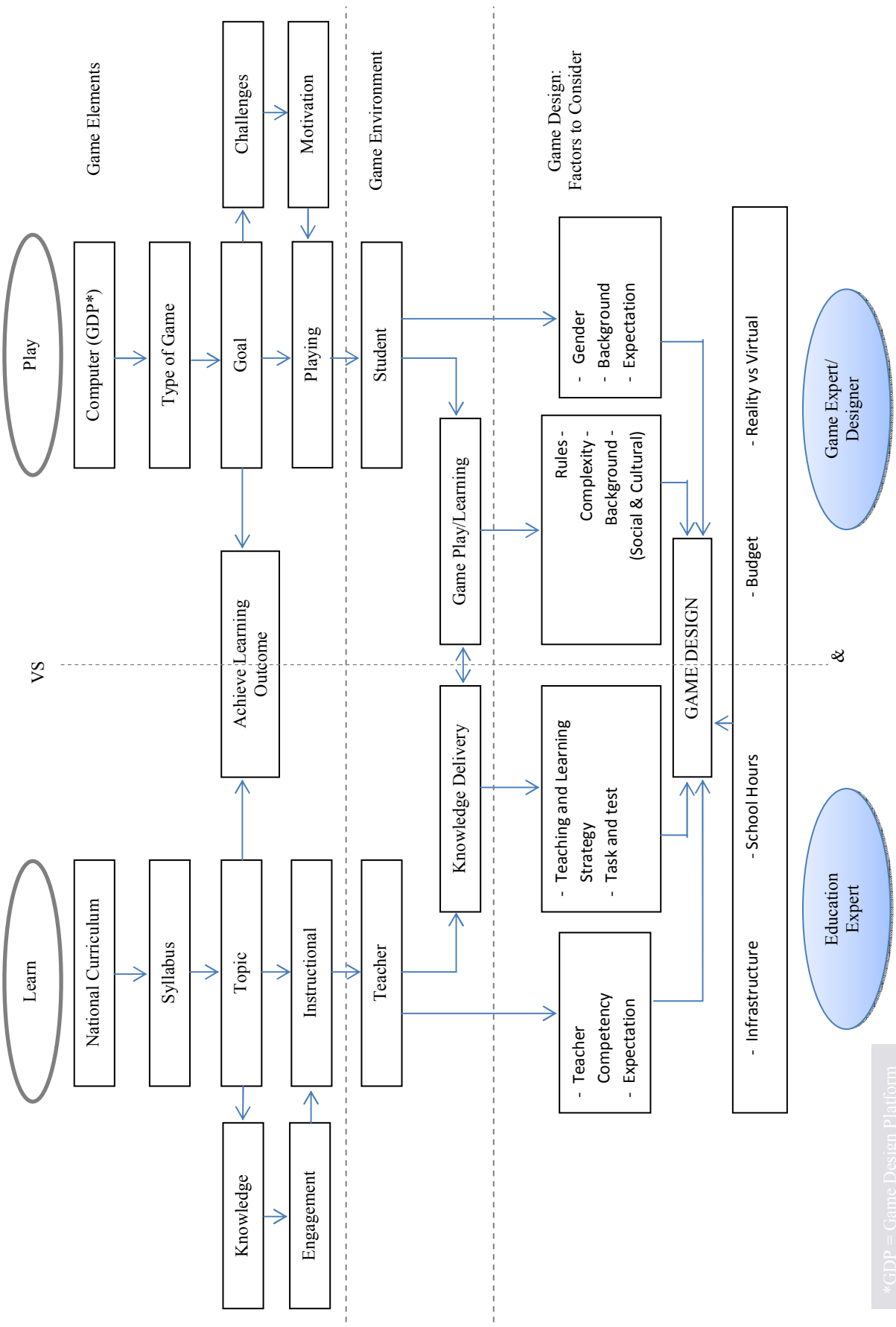

Fig. 1 Educational Computer Game Design Model for Malaysian Classroom

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