TTLC 2013

Computer Game As Learning and Teaching Tool For Object Oriented Programming in Higher Education Institution

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Abstract

The purpose of this study is to identify and evaluate how the computer game could apply as a tool for teaching and learning object-oriented programming in higher education institution. Nowadays, computer games have widely applied in learning process due to the burgeoning computer use in the market. Therefore it is necessary to conduct a study on these matters to propose an efficient and effective educational computer game for higher institution learning and teaching process.

1. Introduction

On these days, computer games have been adopted as part of the teaching and learning tools in education field and training field. Computer games often gives negative impact because most of the people treats computer game as an addiction to the students. However, some studies show that the same syllabus as traditional teaching approach, by using computer games as teaching and learning tools, the students could pick up the skills and knowledge much more efficiently. Thus, computer games have great potential to assist teachers and engage students in a new and

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challenging way. The purpose of this study is to identify and evaluate how the computer game could be applied as learning and teaching tools for teaching object-oriented programming in higher education institution. Nowadays, computer games have widely applied in the learning process in education field due to the increasing of computer use in the market. Previously, most of the people felt that computer games are only for children, but soon, people found that this perception is wrong, not only children need games as entertainment; adults too. Adults could relieve their tensions and stresses by delving in the virtual world of games. Besides that, by using computer game as a learning tool, it will increase the student leaning and understanding capabilities. This is because educational computer game will provide an interaction context for the student. Students could interact with the game and get back the feedback or response immediately. In this modern era, most of the learning centres, range from primary to university level, were equipped with computer facilities, and this is reason to think about how to fully utilize those provided resources. One of the approaches is to use the computers as learning and teaching tools. Therefore, this study seeks to fill the void in research determines of computer game adoption as learning and teaching tools for teaching object-oriented programming in the higher learning institution in Malaysia.

2. Literature Review

Nowadays, the traditional way of teaching programming is not attractive to students (Shri, R., Wai, W., Peter, C., 2006). For example, conventional lecture and tutorial classes are not adequate and provides only one-way learning environment. Most of the students nowadays prefer to have more freedom and self-learning approach. With the new teaching and learning pedagogy, most of the university are adopting student-centered learning approach. Computer games are one of the suitable tools to fit in the student-centered learning approach. This is because computer games are not only for entertainment, but it is capable to provide a substantial self-learning environment for the student. Object-oriented programming paradigm is one of the widely adopted programming paradigm in the IT industry, however it also one of the most challenging programming paradigms to the student to learn. Most of the computer science stream students are not able to understand and visualize the concept of the object-oriented programming paradigm. Thus, it is necessary to use computer game as the teaching and learning tool to reduce the complexity of learning object-oriented programming for the student as well as provides an efficient object-oriented design learning environment for them.

2.1. In-game functionalities and Interaction

This study is providing an opportunity for students to participate in the learning process via computer games with the in-game function and interaction (Pieter, W., Herre, O (2013). This is because functionalities of a computer game are important elements when designing a computer game that could easily remember and accepted by players. Besides that, computer game is an effective tool to use in teaching and learning processes because computer game provides an opportunity for player to interact. Interaction is one of the essential elements in learning process. This is because interaction in a computer game will require the participants to provide their inputs, and construct their instruction. Participants also could get back the feedback or reaction from the game. This is vital in learning process. By participating in an interaction the learners could easily understand the concept or main point that carry out form the game.

2.2. Game Design

Basically, the educator’s concern is how computer game relates to the teaching environment with minimum violation of the learning objective. This is crucial for the game designers to answer this question. Therefore, effective game design is a very important process for the game designer. Game industry is very wide and full of great opportunity businesses. In average, children could play up to 10,000 hours of game in a year nowadays. Because of this huge popularity, a lot of researchers are helping the game developers to explore the possibilities of using game as learning and teaching tools. Originally, the first education computer games have been designed as drill-and practice game for the learner. Normally the format of this type of games like problem or multiple choices question about so intended topic within the context of an unrelated story. However, these kinds of education games are different from the commercial game. This is because the drill and practice game only embedded with basic single goal compare to the commercial game with plenty of goals need to achieve. The most common game genre
for the education games are simulations and role person games (RPG) (Luigi, C., Alfredo, S. 2008). The simulation games are suitable to apply to the education context because participant or learner will give full control of the gameplay and react as the game hero of the game. Based on this circumstance, student will have a simulation environment for them to practice on particular skill or technique. This is because RPG games normally required student act the character of the game and solve problem or puzzle within a circumstance where it needs learner to collect necessary informative information. Thus, this study proposes a simple role-playing game as teaching and learning tool to teach object-oriented programming in classroom teaching. The main objective is to demonstrate how efficient to teach and learn object-oriented programming via computer game.

2.3. User interface and Storyboard

Basically all computer games have to deliver certain of interaction and communication to the person who participates in the game play. In order to use computer game as learning and teaching tools certain question should be answer such as:

- How the interfaces teach the learner?
- The story board of the game
- The rule of the games.

The most important concern for computer game is how to retain the student focus on the gameplay. One of the significant aspects is the user interface. This is because without a user friendly and easily-understand interface, learners will get bored and frustrated easily, and thus end up leaving the game. Besides that, the user interface represent the first impression deliver to the learner it also the first thing to teach learner from the game. A clear and simple interface will make the learner having better and more comfortable feeling. Normally, most of the games are provide tutorial to the learner. Learner can explore themselves to the tutorial to get more detail of the gameplay. Therefore game designer should take consideration when create the tutorial for the learner. At this stage, learner will explore the entire game and gets amused as well. For example the game Banjo Kazooie, in the first level of this game, the player must demonstrate the ability to complete certain important tasks. Meanwhile, there is a tutor to help if the player gets stuck, but they don’t have to listen to the instruction (Pagulayan, Keeker, Wixon, Romero & Fuller, 2003). For this study, the researcher was applying 2D tile based design for the game interface. Another major concern for education game development is the overall game storyline and flow (Amy B.Adcock, , Ginger S, Watson, , Gary R. Morrison 2008). As in learner’s point of view, progressive learning is one of the effective learning methods especially for the topic that mostly interrelated. In order to include the progressive learning to the proposed game, narrative storytelling method had been adopted to deliver the game story and flow to lead the students to learn object-oriented programming. Students are able to learn step by step by completing each level in the game world. Nevertheless, game mechanics and rules are also another important elements need to be considered when developing an education game. Overall game mechanics for the proposed game are mini puzzle game. Each mini puzzle game is representing each covered topic with learning contents and the puzzle game as assessment to test the student understanding about the covered topic. Students need to complete the mini puzzle game as the pre-requisite to next level or next learning topic.
3. Game Construction Framework

The proposed role playing game was developed based on one of the game construction framework from Amory and Seagram (2003). This framework includes three sub models; GOM (Game Object Model), POM (Persona Outlining Model) and GAM (Game Achievement Model). This model focuses on the game learning objective in the initial stage and focuses on the actor within the gameplay subsequently. In addition, this framework also mentions the significance of the storyline of the game being developed.

The purpose of GOM is used to help game designer to define the learning objectives and the components in the game necessary to fulfill them. For this study, the game is required to include the learning objective of the selected module with necessary appropriate topic. Meanwhile, POM is used to help game designer to organize who are the...
actors in their game and what role they will play in the game story. The actor selecting process is very important to the education game because actors are the one who interact directly with the player or learner. For this study the main actor is student. Therefore the learning expectation and requirement are significant for game designers. Finally the GAM model is the last layer of this framework. This model is responsible to define the interface and the storyline of the game. GAM model is also another essential model to this framework because one of the most important aspects of game is the storyline. Storyline of the game is important because it kept the user or learner playing on the game, to find out what happens next. For this study, the researcher proposed to use narrative method to carry the storyline. Besides that, a good storyline or background story able to help designer to identity the character being involve in the game.

3.1. Proposed Game Detail

Ztech de Object-Oriented is an edutainment game that guide users to learn Object-Oriented programming in an easy and relaxing environment. It is more like a game in which players or users will go on with the flow of the program step by step and they will learn to grow their characters (Ztech). To enhance the learning process, this game must have an attractive storyline, pleasant game environment, nice and suitable sound effects, elegant character design as well as great animations. When the game starts, the character will have the navigation system that allows it to travel around the game map. In order to become stronger and more powerful, they have to fight with their enemies, the terrorists. Apart from that, there will also be some NPCs that will help the character by providing them with some missions.

When you finish the mission, you can earn a great deal of rewards, either increasing experience or improving their current abilities by obtaining new equipment. As the users are having fun with the game, they are actually learning the invaluable object-oriented knowledge. Ztech de Object-Oriented is a stand-alone game in which each player will play and learn in their own application. The game will guide users in an appropriate way so that users can truly understand the concept of Object-Oriented. The purpose of having the gaming part is just to increase and foster the interest of users to learn the knowledge. Through the game, the application will provide users with all the basics of Object-Oriented concept like encapsulation, inheritance and polymorphism. In addition, the game will also include some basic programming concepts that further improve the users’ understanding. Besides, there will also be 10 mini puzzle games which are applied with basic programming knowledge through 5 levels in the game. By this, Ztech de Object-Oriented will serve as a catalyst to smoothen the path of learning Object-Oriented concept.

This game has a maximum of five levels for our main character. First and foremost, we will introduce the basic knowledge of object-oriented approach to our players. They should pass through their first level when they have gone through the Objects and Classes test. In level two, the game will guide the players to learn about the control statement like if...else and switch...case as well as the structure of method declaration. On the third level, the game will guide the players to learn about the array and also the three types of looping statements. Quests will be assigned to the players to ensure that they truly understand the concept behind the knowledge. By completing the quest, players can continue to the next level or stage. On the forth level, players start to learn about the main principle of object-oriented. They will be taught about the concept of encapsulation and inheritance. Examples are provided to bolster their understanding. At last, the game will guide the players to learn about the polymorphism principle. The game ends when the players defeat the last boss, Virus. From time to time, reward will be given to the users to appreciate their learning enthusiasm. By this way, users are encouraged to continue to learn up the new knowledge and skills.
3.2. Game Levels’ Screenshot
This is a puzzle game. I will rearrange all puzzles and you will need to arrange it back within 60 secs. If you are ready, press [Enter] to start the game.

Array declaration is given and you will need to answer all the question correctly. Are you ready to answer the question? [Enter] for Yes.

This is the Polymorphism test. I hope you will take it seriously.

This is the next question. If you can solve it, you win the game. Press [Enter] to start.

SELECT [Enter], BACK [Esc], UP, DOWN.
3.3. Data Analysis, Finding, Implication and Result

The researcher had selected one of the degree modules named Introduction to Object Oriented Programming for this study. Total of 40 students from 2 programmes (Bachelor of Computer Science and Bachelor of Software Engineering) have been participating in this study. The selected subject best fit to this study because the content and the topic covered is the fundamental of object oriented programming. Based on the observation from the class conducted, most of the students are enjoying playing the game as they can concentrate on the learning topic. They are excited about the game play as well as the topic covered. Besides that, some of the students did discuss among peer about the game quest as well as the particular topic.
3.4. Questionnaire Analysis

A set of questionnaire that consists of 10 questions was given to all the participated students. The given questionnaire mainly serves as a platform for the student to comment and provide constructive opinions about the game. First question is to find out the gender of the participated students. Based on the data obtained, the ratio of the gender is 20% female versus 80% male. According to the data or feedback obtained from the questionnaires, 86% from the student responded game based learning approach is better than traditional teaching approach.

As mentioned user interface design for the game is one of the significant elements to provide an effective learning environment, this can be shown by the data obtained which 86% of the students agreed that the user interface is a significant element for game based learning environment. Another important element for game based learning mentioned is in-game storyboard. There are two ways to carry out the in-game storyline to the student which are narrative approach and simulation approach. Based on the response given by the student, 60% of them prefer simulation approach compared to narrative approach, which is only 40%. Besides that, another major objective for this questionnaire is to find out which game genre is the best for the computer game to teach and learn object-oriented programming. From the participated student response, 50% of them selected Role Playing Game, 30% selected Puzzle game and 20% selected Simulation Game.

Besides that quantifiable data, participated students also have given some constructive ideas to improve the computer game as shown below:

- More animation feature and better graphic user interface as motivation for the student to retain focus
- More puzzle games needed to make it more challenging for the students
- Include more advanced topic of object-oriented programming and provide more problem-solving based learning example
- Include more fun element by adding more interaction such as surprise facts, reward system and etc.

As a summary, most of the students agreed that the computer game able to meet the learning and teaching objective. Besides that, all of them agreed that game based learning is an effective tool for learning and teaching object oriented programming. This is because among 40 participated students, 16 students obtained grade A for the Introduction Object Oriented Programming.

4. Conclusion

As a conclusion, computer games can be useful learning and teaching tools for object-oriented programming. However, it is important to bear in mind, play is one of the very first and most effective ways that learners can get about whatever knowledge they required. Computer game can be an engaging learning medium for the teaching and learning process. Meanwhile computer game can guide the learner step by step to achieve the objective of the learning process base on the learner skill and their preferences. However, there are many challenges facing and still need a lot of improvement and researches for the integration of computer games into higher learning institution. Thus, it is necessary to carry out this study to find out some suitable and efficient approach for developing an educational game in higher learning institution for teaching object oriented programming.

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