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IC - ITECHS 2014

The 1st International Conference on Information Technology and Security

Malang, November 27, 2014

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Lembaga Penelitian dan Pengabdian pada Masyarakat

Sekolah Tinggi Informatika dan Komputer Indonesia



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LEMBAGA PENELITIAN & PENGABDIAN KEPADA MASYARAKAT

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GREETINGS

Head of Committee IC-Itechs

For all delegation participants and invited guest, welcome to International Conference on Information Technology and Security (IC-Itechs) 2014 in Malang, Indonesia.

This conference is part of the framework of ICT development and security system that became one of the activities in STIKI and STTAR. this forum resulted in some references on the application of ICT. This activity is related to the movement of ICT development for Indonesia.

IC-Itechs aims to be a forum for communication between researchers, activists, system developers, industrial players and all communications ICT Indonesia and abroad.

The forum is expected to continue to be held continuously and periodically, so we hope this conference give real contribution and direct impact for ICT development.

Finally, we would like to say thanks for all participant and event organizer who involved in the held of the IC-Itechs 2014. We hope all participant and keynote speakers got benefit from this conference.

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Developing Computer-based Educational Game to support Cooperative Learning Strategy

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Abstract

Game is one of learning media which can be used as a part of learning strategy in school nowadays. Learning strategy using game can be more effective for students especially for developing mathematical skills of primary school students. Educational game development can use Waterfalls model, where development phases can be adjusted to be in accordance with the development needs of educational games. Educational games have teaching material therefore they can be used to support learning strategy in classroom.

Keywords: *educational game, cooperative learning, computer game*

5. INTRODUCTION

Generally games can be categorized as follows: a. *educational games*, b. *leisure games*, and c. *educational leisure games* (Ulicsak, 2010). Educational Game is developed with teaching material, which is explicitly directed to support learning and teaching process. In this research, *educational games* are employed, or in some literatures they are called as *instructional games* (Kebritchi, 2002). In learning activity at conventional classroom, students who cannot understand basic concepts will be left behind, therefore this will create gap in basic knowledge which will influence the next stage involving more complex concepts. In the meantime, in educational games the players can repeat any concept that they do not understand over and over until they master it.

According to Gredler (1996), there is relational limitation between educational game and the discipline of learning theories. Lack of understanding of learning aspect of game causes obstacle for placing learning design and control to learning outcome of game (Egenfeldt-Nielsen, 2005). In the last several years, there are many games that have been designed and become practice from the design process (Quinn, 1994; Mayer & Veeneman, 2002; Kirriemuir & McFarlane, 2003). Educational game which are developed with learning theory can be promoted as an instrument of modern learning theory in classroom (Amory & Seagram, 2003).

There are three important aspects of learning games: motivation, skill development, and *immersive learning environment*, which will be discussed in the following sections.

1) Motivation

Participation and motivation have determined outcome in the long run with the use of games in the learning process in classroom (Joyce, Gerhard & Debry, 2009). This is caused by the nature of game which offers three motivating factors, i.e.: fantasy, challenge, and curiosity (Malone, 1981).

- a) **Fantasy.** Fantasy is related to the use of imagination and children's habit which is attached to playing (Opie & Opie, 1969). To play in a structured way, either using dolls/puppets, Lego brick, or video games, is considered by Vygotsky as a strong learning tool (Vygotsky, 1978).

- b) **Challenge.** Challenge is created through tasks or puzzles in games and if they are balanced with children’s development phase, that challenge is in *zone of proximal development (ZPD)*. ZPD is a Vygotskian term to describe phase for skill level development which is assigned to learners, where their tasks are to make changes in order to push skill development through stages, without difficulties to accomplish (Vygotsky, 1978).
- c) **Curiosity.** Curiosity here means to test the game, to explore “what will happen if I do this” repeatedly, in accordance with playing habit and how children use space to explore and experiment their world.

2) Skill

The exact skills as direct outcome of games with relaxed and strategic environment remain debatable. A critical review of educational game potential has been conducted by TEEM, an organization focusing on evaluating educational softwares. TEEM employes teachers as evaluator of game simulation application based on searching. They found that there are many skills which can be developed including: strategic thinking, planning, communication, application number, negotiating, group decision making, and data controlling (McFarlane, Sparrowhawk & Herald 2002).

3) Learning Environment

James Paul Gee reconstructs critical dimension of digital games, which can make strong learning environment (Gee, 2003, p. 18). *Semiotic domain* for game is a world or culture which is created and shared in a game, where players can share knowledge, skills, experience and resources. Active and successful participation in a semiotic domain can be shown by ‘*active learning*’, where group members obtain resources and skills to solve problems, outside the domain of ‘*critical learning*’, which includes thinking on game at meta-level therefore they learn not only how to operate game but also social structure of good game environment (Williamson, 2003).

6. RESEARCH METHOD

The development method for educational game uses software development phases adopted from Pfleeger and Atlee, where the phases of software development are Requirement Analysis, Design, Implementation, Testing dan Operation & Maintenance. (Figure 1)

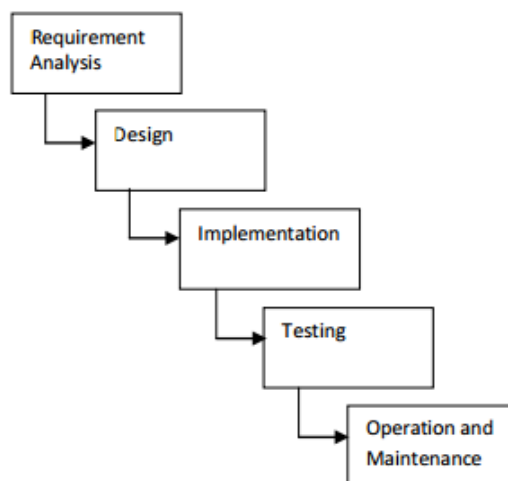


Figure 1. The phases of a Waterfall Model (Adapted from Pfleeger and Atlee)

1. Requirement Analysis. At this phase of educational game development a requirement analysis is conducted, including: selection of learning material, developing questions and conducting question analysis, and developing *cooperative learning* plan.
2. Design. At this phase of educational game development, a game design process is conducted, including: story board, character design, a non-player character (NPC), background design, and playing environment design.
3. Implementation. At this phase of educational game development, implementation is conducted based on requirement analysis and design phases, including: coding, animasi and sound.
4. Testing. At this phase of educational game development, the game software is tested.
5. Operation & Maintenance. At this phase of educational game development, operation and maintenance phases are conducted, including: writing the user manual, handling errors if there is programming bug, and doing analysis for the next game development.

7. RESULT AND DISCUSSION

At the initial phase of software development, researchers select some learning material to be developed, i.e. mathematics for fourth year of primary school. This learning material includes: (1) angle; (2) common division factor; and (3) integer numbers. The research subjects are students in the fourth year of the SDN Lowokwaru 3 Malang, which includes 3 classes, each of which consists of 30 – 48 students. From all the 3 classes, 2 classes are selected (70%) as research subjects. Besides, I also wrote exercise questions, analyzed the questions and also conduct material examination. The result of question analysis is used as guideline for developing questions to be included in the game software. From the question analysis which has been done, a picture is obtained from 30 samples as object research as shown in Table 1. Based on question analysis, the question types which will be used in the game are selected to be at easy, medium, and hard difficulty levels, but they have difference level at very good, good and enough. All questions have been examined materially by mathematicians who are experts in primary schools. The development of learning plan is also made in order to help teachers to use game in the cooperative learning strategy, where game will be used in a group working activities.

No	Keterangan	BUTIR SOAL (PILIHAN GANDA)																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Tingkat Kesukaran																				
	a. Nilai	1.00	0.47	0.80	0.77	0.40	0.67	0.43	0.30	0.30	0.60	0.83	0.53	0.20	0.57	0.57	0.47	0.53	0.10	0.53	0.67
	b. Keterangan	Mudah	Sedang	Mudah	Mudah	Sedang	Sedang	Sedang	Sukar	Sukar	Sdang	Mudah	Sedang	Sukar	Sedang	Sedang	Sedang	Sedang	Sukar	Sedang	Sedang
2	Daya Beda																				
	a. Indeks Diskriminasi	0.33	0.67	0.27	0.07	0.27	0.67	0.73	0.33	0.60	0.80	0.33	0.53	-0.13	0.60	0.07	0.40	0.07	-0.13	0.13	
	b. Keterangan	Cukup	Baik	Jelek	Jelek	Cukup	Baik	Sangat Baik	Cukup	Baik	Baik	Jelek	Baik	Jelek	Baik	Jelek	Cukup	Baik	Jelek	jelek	Jelek

Table 1. Question Analysis

At the design phase, story board which will be developed is adventure game. The goal is to search for treasures, where the players will have to pass 3 game stages, and there are 2-3 mathematical games in each stage. In each assignment there will be scores, time limit, and 3 times chance to play if the player finds obstacle to play. Besides, researchers also developed character design, a non player character (NPC), background design, and playing environment design.

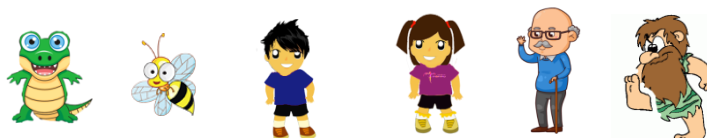


Figure 2. Character design and NPC in the educational game



Figure 3. Example of Playing Environment in a Educational Game

In the meantime, at implementation phase, animation and game development are conducted using Adobe Flash CS 5 and ActionScript 2.0. Thereafter, game is tested using blackbox software testing method and software is tested at SDN Lowokwaru 3 - Malang with a sample consisting of 30 students.

8. CONCLUSION

The development of educational game software can be done using Waterfall model, where the development phases are adjusted to the needs of educational game development. Teaching and learning material should be designed as such to be in accordance with the conventional learning material, and questions should be developed based on question analysis and material examination. These make the educational game able to come near to the learning needs. Teacher's participation in educational game development phase will make it easier for game design and implementation phases.

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