Implementing Computer Games in Formal Learning
(Implementasi Permainan Komputer dalam Pembelajaran Formal)

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Abstrak

Computer games, sebagai bagian dari kemajuan teknologi, telah melahirkan generasi muda yang disebut '*game generation*'. Karenanya, generasi pecandu teknologi ini membutuhkan pendekatan berbeda dalam pembelajaran. Paper ini bertujuan untuk memaparkan potensi penggunaan *computer games* untuk pembelajaran, mencakup keunggulan *computer games* untuk pembelajaran, bagaimana *games* tersebut diintegrasikan kedalam pembelajaran, peran guru dan tantangan dalam penerapan *computer games* dalam pembelajaran. Elemen-elemen dalam *computer games* merangsang keterlibatan siswa, melalui o*pportunities for success, curiosity appeal, simulated danger dan social reinforcement. Computer games* memotivasi dan menarik minat belajar siswa melalui cara yang tidak didapatkan dari pembelajaran formal. Selain itu, games merupakan media tepat untuk model pembelajaran *situated learning and learning by doing* dan untuk mengembangkan kecakapan berkomunikasi dan bekerja sama, penguasaan TIK, pemecahan masalah dan keterampilan berpikir lainnya, serta keterampilan matematis. Pengintegrasian *computer games* kedalam pembelajaran masih perlu mempertimbangkan banyak hal, termasuk kesiapan semua pihak terkait, budaya sekolah, serta keterbatasan waktu dan kurikulum. Namun, setidaknya, sekolah masih bisa mengintegrasikan prinsip-prinsipnya kedalam pembelajaran.

Kata-kata kunci: computer games, learning

Abstract

Computer games, as the part of technology era, have created game generation which consists of young people. Thus, this game-freak generation needs a different approach in the learning process. This paper aims to describe the potential use of computer games for learning, covering the benefits of computer games, how they are integrated into learning, teacher roles, and challenges in their implementation. The elements in computer games stimulate students' involvement, by using opportunities for success, curiosity appeal, simulated danger, and social reinforcement. Computer games can motivate and attract students' interest to study in the way that formal learning process cannot. Besides, games are the right media to model situated learning and learning by doing, and to develop communication and cooperation skills, ICT mastery, problem solving, mathematical competence and other thinking skills. The implementation of computer games into formal learning, however, still needs lots of consideration, including the preparedness of related parties, school culture, curriculum and time limit. Yet, at least schools might still be able to integrate their principles into learning.

Keywords: computer games, learning

Introduction

Learning will happen best when the learners are engaged in the learning process. Papert (1998, as cited in Prensky, 2001) said that learning will be best facilitated if the learners are engaged in challenging activities; and good games, having the quality of challenge, fantasy and curiosity that will encourage engagement and containing principles of good learning, are used to promote learning (Malone, 1981, as cited in Quinn, 1994; and Gee, 2005)

This paper will address the question of how computer games are integrated in formal learning. It is done by first describing the elements of computer games that leads to learning along with some research findings. Then, it continues with explaining approaches used to integrate computer games into formal learning and teachers' roles in the integration. The next discussion will be about issues and challenges in the computer game integration to learning together with some advice for the integration. Advice on the methods to integrate computer games into learning becomes the last part of the discussion, followed by some conclusion drawn from the discussion.

Before embarking to the discussion, it is necessary to clarify two terms related to the research question, i.e., computer games and formal learning. There are many terms used to describe specifically-designed computer games for learning to differentiate them with those which are not specifically built for learning (referred to as commercial-off-the-shelf /COTS games). They are such as digital learning games (Prensky, 2001), educational computer games (Quinn, 1994), and educational electronic games (2005). In this paper, the term computer games will be used to refer to both educational games/digital learning games/educational electronic learning and COTS games as well as video games played in computers instead of game consoles. Meanwhile, the term of formal learning is referred to learning occurred in formal levels of education, from primary, secondary, and tertiary.

The implementation of computer games in the formal learning covers wide areas of study, including game design, cost, resources, facilities, learning-game integration methods, curriculum, evaluation, preference, gender and the like.

However, this paper will mainly focus on the methods and issues related to their integration into formal learning since it is considered as the main part of the answer to the research question.

Although important, the details of curriculum and facilities, gender and preference as well as cost-related issues are not discussed in this paper because of its linkage to a vast area of study and of the lack of time.

Games and learning

Since their first appearance in 1974, commercial video games have introduced what Prensky (2001) called as 'a game generation'. With the average years of players all over the world were between 8 and 29 years old in 1995, according to Durkin and Aisbett (1999, p.31), today, this generation has filled the classrooms, from elementary to tertiary levels, and entered job fields.

Tuzun (2007) characterized this younger generation as being different from the older generations. Quoting Frand (2000), he mentions the characteristics as follows:
1. computers and the Internet are a part of their life,
2. staying connected through technology is essential,
3. multitasking is natural, and
4. doing is more important than knowing.

With these characteristics, it is not surprising that this generation have become disengaged with traditional teaching approaches such as lecturing, as Prensky (2001) and Van Eck (2006) argue**.**

Advocates such as Gee (2003) and Prensky (2001) indicate that video games match the characteristics of the younger generation, who grew up playing video games, and that they can be incorporated into classroom learning to connect with this generation. It is also argued that by playing games, young people are developing competencies that are equipping them to work and communicate effectively in the twenty-first century.

The explanation above raises a question as to what makes games effective to learn. Games, according to Prenksy (2001), have twelve elements that make them engaging; they are:

1. fun/enjoyment,
2. a form of play, or rules,
3. goals,
4. interaction,
5. outcomes and feedback,
6. adaptation,
7. win states,
8. challenge,
9. problem solving,
10. representation and story

Those elements stimulate engagement which then leads to enjoyable, compelling and effective learning (Lepper and Cordova, 1992, as cited in Amory, Naicker, Vincent & Adams 1999; and Prensky, 2001).

The research findings from Ahlers and Garris (as cited in Prensky, 2001, p.147) provides vivid picture of how games encourage engagement, namely:

1. opportunities for success (from the game's goals, rules, and control of one's destiny) leads to a sense of purpose;
2. curiosity appeal (from surprise, complexity, mystery, and humor) leads to fascination;
3. simulated danger (from conflict, sound, graphics, and pace) leads to stimulation; and
4. social reinforcement, (both real, from online conversations, and game chat rooms, and simulated, from scoreboards and game interactions) leads to a sense of competence.

However, it should be noted that not all games encourage learning. Only those which are able to successfully combined fun and aspects of instructional design and system design that include motivational, learning, and interactive components will benefit learning (Quinn, 1994).

Advantages of games for learning

There are increasing numbers of research about the relationship between computer games and learning. Firstly, computer games seem to provide motivation and interest for young people to learn "in a way that formal education does not" (Facer, n.d.). Therefore, many experts are driven to harness this motivation for learning. Some researchers, including those from Tapscott's Net Generation and on educational psychology, argue that regular and intensive game play can develop a set of new cognitive abilities in young people. Prensky (2001), then, summarizes those new cognitive abilities into ten characteristics, namely:

1. Twitch speed vs conventional speed
2. Parallel processing vs linear processing

3. Graphics first vs text first
4. Random access vs step by step
5. Connected vs stand alone
6. Active vs passive
7. Play vs work
8. Pay-off vs patience
9. Fantasy vs reality, and
10. Technology as friend vs technology as foe

Secondly, since lecture-based model of teaching in schools and universities is not effective to ensure learning, teachers need new forms of learning. Learning by doing and situated learning are two models of learning which can be best conducted in the gaming environment. It has the potential to both motivate and encourage diverse ways of engaging with learning. Games then are seen to generate motivation through "rule-based, goal-directed challenging play, which would generate hard fun" (Facer, n.d.).

Furthermore, BBC News (2002), reporting on a study about the use of games in the classroom conducted by Teachers Evaluating Educational Media (TEEM) Inggris, states that computer games contribute to the curriculum by developing key skills, such as:

a. Communication and working with others – the game requires the students to communicate with other students, to describe what is taking place, to share resources, to make arguments and debate actions.

b. Problem solving - the games provide a set of challenges that students must overcome in order to complete the game successfully.

c. Mathematical development (application of number) – computer games (such as simulations) require budgeting decisions, and thus encourage financial capability.

Similarly, a study by Becta (as cited in Facer, n.d.) found out that games develop:

a. Students' ICT skills acquisition, especially ICT skills needed to play the games
b. Motivation/interest in activities-games generate self-motivation
c. Collaboration-students might choose to work together to complete games, learning from and working with peers.
d. Thinking skills, such as reasoning, enquiry, creative thinking, evaluation of actions, devising strategies, rational decisions, and logical thinking.

Gee in Science Daily (2010) mentions several ways in which video games optimize learning, namely:

1. Games provide information when it is needed, rather than all at once in the beginning. In learning science, for example, usually teachers tell the students a lot of stuff and then let them do science. Games teach the other way by having students do stuff, and then as they need to know information, the games tell the students about it.

2. Games also provide a 'pleasantly frustrating' environment, in which are the activities/games are challenging but still doable. Therefore, it is a very motivating for the students.

3. Games also provide alternative, comprehensive assessment. Typically, assessment happens through standardized testing. In games, however, learning and assessment are closely related. The game gives constant feedback and collects information about players' performances. Then, they can be put into statistical data.

All of aforementioned benefits make games worthy of efforts to integrate them into learning.

Approaches to integrate video games and learning

There are three approaches that educators have used to integrate video games into their classrooms (Van Eck, 2006), namely having educators and/or developers design games from scratch, having students design games from scratch, and integrating commercial off-the-shelf (COTS) games into classroom learning.

1. Student-design

In this approach, students, with the help and guidance from teachers, design the computer games about a particular subject they are studying (Prensky, 2006). This approach are also used by Amory (2001) with his undergraduate students to develop a an educational game called *Zadarh.*

While it is believed that students will learn the content while designing the game, and develop problem-solving while learning programming languages, this approach shows some weaknesses. Van Eck (2006) mentions at least two weaknesses in this method:

1. time

It is a time-intensive process, although the quality does not have to be equal as the commercial ones. Not all teachers and students can devote their time needed for game design. Moreover, in traditional curriculum settings, teachers and students have to catch up with the content to be covered.

2. expertise

Students and, especially teachers, need to have the skill sets needed for game design; yet, not all teachers and students have them.

2. Educators-and/or developers-design

In this approach, educators and developers, working together or individually, design educational games to suit their specific classroom needs. There are several principles that need to be taken into account in designing these educational games. Besides principles of balance, creativity, focus, characterization, tension, and empowerment quoted from *The Next Generation* magazine (1997), Prensky (2001) adds a clear overall vision, constant focus on the player experience, a strong structure, high adaptivity, flows state, frequent rewards, exploration and discovery, mutual assistance, a very useful interface, and the ability to save progress as the elements of a good game. Furthermore, he suggests that, capturing the style and techniques of combining the elements in successful, readily distributed games and game genres are also necessary to create a good learning game.

Ideally, computer games used in education are the products of this approach, and this therefore ensures to meet the needs of almost any domain and balance the education and entertainment values (those referred to as serious games in Van Eck, 2006). Moreover, as Ce Embi and Hussain (2005) suggest, a good locally made or home-made educational game products will address the issue of curriculum, culture and content better than foreign products.

However, according to Van Eck, this approach needs more resources than the first method due to the expectancy to be equal in quality and functionality with COTS games. As Ashley Lipson, quoted in Prensky (2001), said "to be an entertaining and educational game, it must first be a game, and only then, a teacher." Moreover, there are also traumas of failure from the past in building such games, either in the production or distribution, which make investors or companies are reluctant to invest their time and money for such games. Not until people are convinced of the effectiveness and efficiency of games for education is this type of games will be widespread.

3. Commercial off-the-shelf (COTS) games integration

COTS games are not specifically designed as learning games; therefore, they are often limited in topic, providing inaccurate or incomplete content.

However, since the first and second approaches are considered time-intensive and resource intensive processes, Van Eck believes that integrating COTS games and learning is currently the most cost-effective of the three in terms of money and time and its usability with any domain and any learner. He also believes that integrating COTS games for learning are the most suitable way for introducing games for learning and convincing people to serious games, which is confirmed by Tuzun (2007).

The preference of using COTS games can also be derived from Sanford, Ulicsak, Facer and Rudd (2006) who suggest that, in contrast to a major barrier of the lack of realism in the game models for COTS integration, the teachers in their study were comfortable working with COTS games and able to operate with a principle of 'sufficient accuracy' for the task at hand.

Despite its findings that almost three in five the UK teachers want to use computer games in the classroom and its alignment with Sanford, Ulicsak, Facer and Rudd (2006)'s findings, a MORI poll reveals some barriers in the use of computer games in the classroom (http://www.futurelab.org.uk/about_us/press_releases/pr11.htm accessed on 14 May 2007). The barriers are lack of access to equipment and of strong evidence of educational value of games, appropriate choice and suitability of computer games to be used and stereotypical views of anti-social behaviour of computer games.

Addressing the barriers, Van Eck (2006) proposes the following steps in integrating COTS games into classroom:

1. game suitability

Whether the explicit content, or the underlying strategies and the game play match the content of the course; Van Eck claims that almost all games have instructional potential if one could examine the basic structure.

2. alignment of the game and the curriculum

Whether a game will be used as a pre-, co- or pre-instructional strategy is determined by the curriculum needs and the game structure; both have to be balanced to maintain the quality of their interaction. Regarding the curriculum, Sandford, Ulicsak, Facer and Rudd, (2006) claims that the success of a game integration into classroom is influenced more by the particular context of work, rather than the particular curriculum a teacher follows.

3. alignment of the game and the content

Since topic coverage is admitted to be major limitation of COTS games, teachers are suggested to utilize various viewpoints about the topic in the curriculum.

4. game design and evaluation

After choosing the type of game and analyzing its content, teachers should make additional activities to fill in the missing or inaccurate content while keeping the activities within the game world as much as possible to maintain motivation and flow.

5. ultimate decision

Van Eck suggested that the justification of the amount of work and time spent in implementing the game should balance with the potential learning the game has. If it is not justified, the idea of using COTS games should be left behind.

Just as seeking for justification for the implementation of COTS games, teachers should also consider technical infrastructure of the school such as personnel and facilities; institutional and professional factors such as scheduling, the culture of the school; the extent of appropriating and disaggregating the games for specific needs; teachers' gaming experience and teaching/professional experiences; and teachers' cultural expectations of children's games literacy and motivation (Sandford, Ulicsak, Facer and Rudd, 2006).

Teachers' roles in digital game-base learning

Van Eck's statement (2006) that games are effective not because of what they are, but because of what they embody and what learners are doing as they play a game implies the importance of roles a teacher plays in this computer game-based learning. Prenksy (2001, pp.347-353) lists the teachers' roles as follows.

1. Motivator: teachers deliver lessons using style and passion to engaged them in learning, understanding students and steered them toward learning games.
2. content structurer (integrator, reformulator): teachers structure the content to be effectively presented.
3. Debriefer: teachers help students reflect on what is being learned.
4. tutor (individualizer, steerer, selector, adjuster, guide, facilitator): teachers guide and facilitate learning, organize and direct entire learning experience of their students, setting objectives and accept responsibility for their student's progress.
5. producer/designer: teachers may design or produce games suitable for their students.

Issues/challenges in using games in classroom context

In his case study on the implementation of video games in three levels of formal education in Turkish context, Tuzun (2007) discovers four issues related to their implementation in the classroom. The settings are, in my opinion, more or less similar to Indonesia, in that both applies traditional curriculum and have less-equipped facilities. Therefore, I assume that the implementation of computer games in formal learning in Indonesia will have to address the similar problem.

1. Design of the video game environment

There are several challenges in the designing a game which is relevant to the topic. They are excessive design time, a relevant backstory for the game, students' higher expectation of the game and its environment, the necessity for orientation due to the game symbols system, and time constraints of lessons.

2. School infrastructure

Access to computers and Internet, game installation on the computers, emergent technical problems, and lack of immediate technical support to solve the problems becomes the challenges to implement games in learning.

3. Nature of learning, role of teacher and classroom culture

In this area, Tuzun names teachers' changing roles, messy culture, and increasingly less instructional utility of the collaborative discourse as parts of the challenges of game implementation.

4. Engagement

The last challenge is that, while enjoying the learning, some students also find a difficulty in balancing entertainment and learning to finish the task on time. Therefore, the engagement occurred is 'misplaced'.

Above all, Squire (2005) considers that still bigger challenges are changing school culture and designing a good educational system for educational games to flourish in.

In conclusion, the challenges to in designing a good educational games or bringing in games into schools are those related to the cost of game development and sustainability; time for the design and implementation; availability, adequacy and reliability of IT infrastructure; and school' cultural infrastructure and educational system currently applied.

Che Embi and Hussain (2005) present a dilemma in the implementation of educational computer games for learning, regarding the choice of computer games which are suitable with the specific environment a teacher has. They discovered that local (the Malaysian) products do not have most of the criteria of a good educational game except for content, error

correction mechanisms, and challenge. Meanwhile, foreign edutainment products have almost all of the characteristics. However, besides costly, they do not cover the local curriculum and might not be suitable to the local culture.

Advice on using computer games in formal learning

From the discussion related to the use of computer games above, it can be concluded that integrating computer games into formal learning takes much energy and resources, of which not every teacher or institution is able to obtain. However, enticed by the potential of games for learning, it is still possible to take several suggestions given by researchers such as Prensky (2006), Gee (2003), Squire (2005) and Van Eck (2007) such as:

1. If possible and have a brilliant idea, develop a new game from scratch; or, bring the design to game developers. It is in fact not an easy thing to do because not every developer is willing to develop such games due to the exhaustive resources required and past time failure. However, as Prensky said, there will be a way to solve this problem and there are already some good examples of it (e.g. the Dan Rawistch-the Oregon Trail, Roger Bohn-Kristen's Cookies etc).

2. Turn your students into game designers. The students, working either as a group, teams, or individuals, can try to invent a game or games about the particular subject you are studying. Students will be benefited from the skills developed along with the implementation and better understanding of the lessons. Then, you can create the game yourself; have your capable students to create the game, no matter how simple it is. This is what Amory (2001) did in his classroom.

3. Play in class a game which is specifically designed for education, either by projecting it at the front of the room or have students play individual game sessions, either by themselves or in teams in one computer, depending on the existing facilities. There are some parameters that help teachers choose a good educational computer game such as content/storytelling, interface, interactivity, challenge, fantasy, feedback, curiosity, control, mechanisms, and representations (Ce Embi & Hussain, 2005).

4. Observe options of commercial games that might be suitable to the teaching situation and topics as many as possible. Talk to gamers, and try the game yourself. Play it in class, either a whole class (projected in the front) or as individual students playing separately. Then, follow by a discussion related to the game and the topic. When using COTS games, you may either invite students who are playing the game that is relevant to what you are studying to bring it to school and play it in front of the class and follow it by discussion, bring the game you are familiar with and use it yourself in front of the room, with excerpts and lessons prepared beforehand, or have individual students, or groups, play in class.

5. Use video games for learning inside and outside schools, or at least, incorporate learning principles used in good video games inside and outside schools even with/or without the games themselves. For example, use the game as homework, brings games played outside of the class into the classroom through questions, discussions, etc, or use the principles behind good, complex games to make some or all of your teaching more game-like, and therefore more interesting and engaging to students. There are, at least, two game principles that can be applied. The first principle is putting student engagement as the top priority. The second principle is increasing the pace of decision making in the class.

It is worth noting that the level of adoption of computer games into learning will very much depends on the context on which a teacher works. It should also be noted that motivation by itself does not help students learn. Moreover, there must be minority of

students who are demotivated from games, either because they lack of motivation or have assumption that games and learning are not in the same domain (Sandford, Ulicsak, Facer & Rudd, 2006, p.43-44). They also suggest educators and researchers to look for what specific features are there in the computer games that encourage engagement and use the knowledge in the classroom. Above all, they place quality of instruction that brings about a successful use of computer games.

Conclusion

This paper seeks to find the information on how computer games are integrated into formal education along with its implementation issues to picture the best way to use computer games for learning according to condition of the schools. Quinn (1994), Prensky (2001) and Gee (2003) discuss computer games as one way to engage the game generation in learning along with the elements of computer games that make the games engaging. Sanford, Ulicsak, Facer and Rudd (2006), Van Eck (2006), and Tuzun (2007) discusses approaches to integrate computer games and learning, including strength, weaknesses and issues in their implementation., while Prensky (2001) discusses teachers' roles in the integration. Finally, researchers such as Prensky (2006), Gee (2003), Squire (2005) and Van Eck (2007) gives some tips to maximize the use of computer games in the classroom in accordance to its condition.

From the discussion, it can be concluded that integrating computer games in formal learning is, although possible, quite a hard work in that it relates to the readiness of all resources, school culture and limitation of time and curriculum, and the like. However, no matter the condition of the schools, it is still possible to integrate computer games into learning, even if it is only in the form of adoption of computer games principles.

This paper by no means intends to provide comprehensive picture of computer game implementation in formal education. It only depicts a little information concerning a little why and how to integrate the games in learning. It does not discuss the characteristics of students in each level of education, gender issues and other components of teaching learning, of which I am sure, have great influence in the way computer games are incorporated into learning.

Finally, while games have great potential to support learning, it is clear that there are many things need to be taken into account before the potential can be fully realized.

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