ABSTRACT

We are all aware that game has brought new phenomenon to the children and adults. With playing game; they are sharing the common experience and fully engaged with enormous amount of time and energy. The reasons why most of the youngsters captivated by games because of the challenge elements contained in the game contains that could provide full of excitement, enjoyment and keep their attention focused. Besides that educator, learner and parents also give a positive feedback from the implementation of education game in learning. Act to this, educator and instruction designer need to study the most important element that needs to be injected in the game to make it educationally effective. Therefore this paper highlights the literature review on education game research which focuses on the element of challenge in educational game, the challenge elements that enhance students learning, challenge design in education game with various discipline and advantages of challenge element for the education game.

Field of Research: Game, education game, challenge characteristic, mobile education game.
training exercise at the company sector (Pannese & Carlesi, 2007). It shows that educational game is an effective learning aid not only for student but also for adult. However, there are several importance element need to be added in the educational game in order to be an effective learning aid.

Learning effectively is the way how to learn better and faster. It is important to know how to retain, recall and transfer the learning content of an educational value so that can learn effectively (Cherry, 2013). Learn while playing can be one ways to learn effectively. According to researcher (Moon, & Baek, 2009), an educational games could promote learning because it could motivate the player intrinsically in fun way. Intrinsic motivation is referring to the motivation from inside individual by the external or outside rewards (Bainbridge, 2013). A part from that, Malone (1987) emphasizes four important characteristics in educational game that could contribute intrinsic motivation which are challenge, fantasy, control and curiosity. Researchers who emphasize the good game design should include characteristics such as challenges, goal, feedback and storyline (Pivec, Dziabenko, & Schinnerl, 2003).

The integration of challenge and games can be one of the turning points that make education game become an effective learning aid. Therefore, this paper is to review the integration of challenge characteristic and game in education game specifically in assisting student to gain knowledge.

2. Challenge and Education Game

Education game has been around for some time, but there are still many areas need to be explored. The potential of games as learning tool have attracted researcher attention due to the preferences younger generations. There are a lot of reasons why teenagers are so attracted to the games. A game features makes most of the youngsters always attached to it. According to Prensky (2001), education games could offer correspond learning method with student requirements and interest to urge learning and engage learners better. Act to this, we need to take a significant action to make sure the student could gain something by playing the games. Therefore, education game in the classroom initiated due to its potential in motivating students. Effectiveness of education game can only be produced with good combination of game design and pedagogy content (Oblinger, 2006; Grassioulet, 2002; Owen, 2004; Sauve, 2007; Salen & Zimmerman, 2003). Due to that researcher, educator and instruction design need to collaborate and combined the ideas so that teenagers could gain knowledge trough gaming.

Games have the feature of being intrinsically motivating, which is desirable. There are some factors that make the game so intrinsically motivated to the player. According to Malone and Lepper (1987), games could strongly motivate players to engage (feedback) to problem solving and critical thinking (challenge). Group of researcher also believed that challenge could contribute motivation in education game (Malone, Lepper, 1987; Prensky, 2001; Wang, 2009; Linehan, Kirman, & Roche, 2010). Furthermore, 55.4% of students feel that challenge characteristic as the reason why they play games (Latif, 2007). For that matter, instructional designer need to stress on designing more educationally challenge in education games.

Integration of challenges and game could promote motivation element while playing educational games. Educational games are more accepted when many study have shown an increase in student achievement by playing them compared to learning in conventional way. Based on previous study, game with challenge can enhance student’s learning on various disciplines. In learning Arabic among Malaysian learners, challenge has enhanced respondent attitude and motivation towards learning (Shahir & Alias, 2011). While different tiered-challenge that was implemented in mathematics education game, has made player intrinsically motivated (Hui, 2009). History is one of the bored subjects, however in contrast Civilization III with appropriate challenge make student could learn effectively (Nor Azan & Wong, 2008). English language learning will be more effective if creative approach is taken as learning aid in the classroom environment. Students will be able to benefit by playing language education game. Game with task based activities can be one of the effective techniques in teaching English vocabulary in
the classroom (Huyen, & Nga, 2003), (Efendi, 2013). Task given in education game particularly is to complete challenge such as time challenge, dexterity challenge, endurance challenge and memory challenge (Feil, & Scattergood, 2005). Besides that by playing education game student could gain more experiences and make them able to communicate and do better in “conversation” in English language (Rama, 2007).

3. Theoretical Framework

Theory of learning for this study is grounded on Cognitive learning theory. These theories are based on several of cognitive psychologist such as Jean Piaget (1896-1980), Lev Vygotsky (1896-1934), and Jerome Bruner (1978). Cognitive learning theory is focuses more on how people think (Ormrod, 2008), understand and know. The idea of cognitive approach is to look at the student mental processes rather than behaviour. Cognitive learning is also viewed as an active learning process of knowledge construction (Yilmaz, 2011). Yilmaz (2011) suggested that all the teachers to implement cognitive structure in their teaching in order to help students to integrate new knowledge with prior knowledge.

The important key underlies to cognitive approach is: the memory system as an active organized processor of information and prior knowledge that play an important role in learning. Cognitive psychology have sees human mind similar to computer information processing (McLeod, 2008). Information processing process is dealing with the sequence and execution of cognitive events and it is a generic name that applied to various theoretical perspectives (Cognitive Information Processing Theory, 2011). That makes the reason why, cognitive approach always concentrating on the information transformation in the environment into new knowledge that is stored in mind. Information processing theory that constitute from cognitive learning theory play important role in influencing educational games.

Figure 1 outlines on how information processed in human memory. This model is based on work by Atkinson and Shiffrin model (Atkinson, & Shiffrin, 1968). There are three basic components in Cognitive Information Processing Model (CIPM) which is Sensory memory (SM), Short-term Memory (STM) and Long-term Memory (LTM). Below is the brief description of the three stages (Cognitive Information Processing Theory, 2011):

**Sensory Memory (SM)** - To hold information associated with sense (e.g vision and hearing).

**Short-term Memory (STM)** - A temporary working memory for further process. Working memory usually holds information for a limited amount of time and limited amount of information.

**Long-term Memory (LTM)** - To keep information permanently and capable to retain for unlimited amount with variety of information.

![Cognitive Information Processing Model](image-url)
Information is transformed as it passes from one stage to another memory stages. For example in the classroom student will receive information from the teacher as prior knowledge. Then, student sensory memories will stimulate the initial stage perception. Memory at this stage is temporally limited which means information stored begins to decay rapidly (Lutz, & Huitt,2003). However, student will be able to select or focus on certain information only and the other information will be ignored. In short-term memory stage, it often viewed as active or conscious memory because it is the part of the memory being actively processed while new information is being taken (Lutz, & Huitt,2003). During this stage, concepts from LTM will be activated for use in making sense of the incoming information. Unrehearsed knowledge or information will be lost from working memory in about 15 to 30 seconds. To prevent from the loss and ensure that information is transferred to LTM two necessary processes which are rehearsal and encoding should occur. Rehearsal is the repetition of the information while encoding is a process of relating new information to concepts such as imaginary, mnemonic, outlines and group of information (Cognitive Information Processing Theory, 2011).

Education games are to seen has a strong theoretical foundation for achieving the requirements of Cognitive Information Processing Theory. Education game has potential as the cognitive tools as well as motivation factors to enhance student knowledge. This is approved by Hogle (1996) which believed that educational games may offer a wide variety of benefits such as, increase in interest and motivation, as well as improvement of retention and higher order thinking skills. Challenge in education games may develop student motivation and improve their retention of information in learning.

4. Advantages of Challenge characteristic in Education Game

Oxford dictionary define challenge as task or situation that tests someone’s abilities. According to Malone (1981), challenge is task with a goal and occurs in a situation of uncertain outcome. To make game with uncertain outcome, Malone has discussed several ways including variable difficulty level, multiple levels goals, hidden information and randomness. Variable with difficulty level can be determined by response to the person’s performance at the activity (Malone, 1981). Every challenge initially determine by the game genre as the guide. As for the education game, the game genre needs to be something that related to the learning content. Challenge can be combined in just about any configuration.

Challenge means task or situation to test someone’s abilities. In order to measure their ability, instruction designer prefer to use scoring system so the player always updated their skills and continue playing until they reach the goal. Instruction design believed that the objective and the difficulties to achieve goal are what determine challenge. Therefore, they should know the appropriate challenge criteria for the education game based on learning content. Feil and Scattergood (2005) outline the standard challenge in game that can be reference:

- **Time Challenge** – The player need to complete the task within the time given.
- **Dexterity Challenge** – The player must accomplish some sort of feat that requires dexterity.
- **Endurance challenge** – The player have to complete the task within the time given and to test how far the player can go before he falter.
- **Memory/Knowledge Challenge** – The player have to know certain facts in order to win.
- **Cleverness/Logic Challenge** – The player have to figure out the puzzle without having the answer beforehand.
- **Resource Control Challenge** – The player is given a certain amount of a resource. He must use that resource to overcome an objective before it runs out.

Games could be more fun if it constitutes of challenges and the players masters in a sufficient proportion of the games (Vorderer, Hartman, & Klimmt, 2003). In Malaysia, researcher had indicated
that 55.4% of students feel that challenges as the reason why they play computer game (Latif, 2007). Instead of promote fun in game, challenge also always related on promoting intrinsic motivation and flow. This two main reason become the important key of to make game more educationally (Linehan, Kirman & Roche, 2010).

4.1 Challenge and Intrinsic Motivation

Malone’s motivation theory identify four intrinsic motivation factors in education games such as: challenge, curiosity, control and fantasy (Malone, Lepper, 1987). Educational games need to integrate intrinsic motivation factors into their structure in order to maximize player’s learning (Moon, & Baek, 2009). Most research indicated that game-based learning could encourage learner motivation and leads to better learning performance compared to traditional learning methods (Kang, 2012). Learning motivation perceived by learner in games is always happened as long as they have challenged. Furthermore, an empirical study to compare the learning experience of traditional lecture shows that learners using the game tended to learn more and to be more intrinsically motivated when they actively solved the problems (Liu, Cheng, & Huang, 2011). The role of challenge in education game is very important because it can be normal exercise in the classroom but in more attractive way. Therefore most of students prefer to choose education games as assistant in enhance learning.

4.2 Challenge vs Flow

Good game design should have challenge element because without it the game might be not fun. Challenge has been used to measure player skills towards the games. Furthermore, the balancing of challenge and skills will lead player to the flow state.

Figure 2: Graphical representation of Flow theory (Csikzentmihali, 1990)

According to Csikzentmihali (1990), when people completely focus or motivate on something pleasant activity, they are in flow state. Figure 2 show the flow state theory. Flow state can be measured by challenge/skills while frustration measured by anxiety/boredom which means player will leave the game. Challenge is one of crucial element in order to imbued flow experience to the players. Furthermore, flow experience promising a positive affect for people who are play longer either violent or non-violent games (Chiang, Sunny, Cheng, & Liu, 2011).

Challenge and flow are two different factors that could contribute motivation to their learner. However, there are several similarity and differences between them. From the comparison in Table 2 (Malone, Lepper, 1987; Salen, & Zimmerman, 2003; Csikzentmihali, 1990), both challenge and flow experience is goal oriented. Goal is the reason whereby players initiate the play. However, for other characteristics such as feedback, activity, focus, time and interaction it has different explanation. Most average player will be in curiosity condition trying to complete every single task in order to achieve the goal. They are in beginner and intermediate level. However, player’s who are in flow state normally are in advance level.
Both challenge and flow need their player to stay focus so that they know how to play better and win the game. Player that mainly focuses on victory always sees game challenge seriously to make sure goal is achieve. By doing that, they will stay focused on game until reach flow state and score high mark.

Table 2: Comparison between challenge and flow

<table>
<thead>
<tr>
<th>No</th>
<th>Characteristics</th>
<th>Challenge Games</th>
<th>Flow Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Goals</td>
<td>Fixed goals that relevant for learner</td>
<td>Involved with the goal, goal oriented</td>
</tr>
<tr>
<td>2.</td>
<td>Feedback</td>
<td>Performance feedback should be frequent, unambiguous and supportive</td>
<td>Immediate feedback to player actions</td>
</tr>
<tr>
<td>3.</td>
<td>Activity</td>
<td>Promote feelings of competence for person involved</td>
<td>Require active and directed engagement with optimum experience</td>
</tr>
<tr>
<td>4.</td>
<td>Scientifically</td>
<td>A challenge is a general term referring to things that are imbued with a sense of difficulty and victory.</td>
<td>Flow is the mental state of operation in which a person in an activity is fully immersed in a feeling of energized focus, full involvement, and success in the process of the activity.</td>
</tr>
<tr>
<td>5.</td>
<td>Focus</td>
<td>Uncertain outcomes provide focus.</td>
<td>Full of concentration</td>
</tr>
<tr>
<td>6.</td>
<td>Time</td>
<td>Loss of a sense of passing time</td>
<td>Loss of a sense of passing time</td>
</tr>
<tr>
<td>7.</td>
<td>Interaction</td>
<td>Achieved goals to get level up</td>
<td>Integration of self with activity</td>
</tr>
</tbody>
</table>

5.0 The Challenge of Education Game

Education games without challenge characteristic can be very bored and no fun at all. Students believed that challenge characteristic can motivate make them to keep playing. However, the challenge characteristic should be an appropriate way. Education game development is not an easy work. A lot of aspects need to be considered so that the game can be effectively implemented. This research will discussed limitation of challenge characteristic in education in several aspects.

5.1 Challenges for game designer

According to the theory of mindset there are two types of players who are playing education game that related to challenge. The first one is Achievers or Challenge Avoiders and second one is Explorer or Challenge-seeker. Achievers are fixed mindset whereas Explorers are mastery mindset (Heeter, & Fitzgerald, 2008). Based on the research shows that game designer should concerns on both type of player so that the education game more effective to acquire knowledge. If the game challenge played too hard and the player is Achiever type they will feel frustrated and end up leave the game. While if the game is too easy and the player is Explore category, they might feel bored and also leave the game.

To integrate challenge characteristic and education game becomes one of the big challenges in order to fulfill the pedagogy outcome. Game designer need to know initially what is the game content, genre and student ability. The game with education component must match with pedagogy content in order to achieve the same learning outcome (Braithwaite, & Schreiber, 2009). Therefore game designer and educator need to collaborate together in order to develop an effective game. Game genre will depend on the game content and the players' skill.

5.3 Challenges for educator
Students are the main target for the implementation of education games. The rapid development of technology makes our youngster more vulnerable to the game. Furthermore, most of our kids are considered as computer savvy since that they are easily exposed to technology such as smart phone, Internet and computer. As for student perception, they are strongly agreed with implementation of education game in the classroom (Ibrahim, Yusoff, Mohamed, & Jaafar, 2010; Ibrahim, 2011).

Integration of good game design and good pedagogy content will give a high degree effectiveness of education game (Oblinger, 2006; Grassioullet, 2002; Owen, 2004; Sauve, 2007; Salen & Zimmerman, 2003). To accomplish that, inputs from teacher become indispensable to determine the good education content before incorporating in game (Croop, 2008). Besides learning content, teachers also need to be digital leaders to bring about the change. Skilled staff also needed to promote implementation of education game in the classroom. With that, teachers need full support and resource to implement digital classroom (Jefferies, 2013).

6. Conclusion

Integration of challenge characteristic and education game to promote knowledge is not something new anymore. A lot of study has approved and give positive result about how challenge element in education game could motivate students and enhance learning. Malone (1987) outlined four characteristics that contribute motivation: challenge, curiosity, fantasy and control. Therefore challenge becomes the centre of a game and it need to match with the learning content in order to encourage among the youngster. Challenge always influences their player with intrinsic motivation and flow state. These are the factors make games chosen as an effective learning aid. However, a lot of effort and proper planning need to be carried out to realize these dreams. The implementation of education game in the classroom is not an easy work. There are several challenges has to face by the game designer and teacher especially in Malaysian classroom. First is the integration between educator and game designer to develop an effective game. Second is the readability by the teacher in terms of knowledge, skills and preparation on new technology and learner in digital age.

Acknowledgement

The authors wish to acknowledge the support of the Ministry of Higher Education and Universiti Pendidikan Sultan Idris, who awarded a RAGS research grant for this study.
References


