

LESSONS LEARNED IN GAME PLAYING ACTIVITIES USING PLAYTESTING IN A GAME-BASED LEARNING APPROACH

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Abstract—The ability to use games as a teaching and learning tool requires two-pronged approach, i.e. playing games or/and developing games. This article introduces findings from a research study that focus on learning by playing games, as a game user research field. The study focuses on lessons learned from findings revealing important issues in helping designers to understand users (gamers) and assess on how the designers should serve their needs. By using playtesting approach and procedures, this paper will discuss on the research aim in transmitting the gamer's experiences in learning computing lessons (topics or domains). The objectives include (1) finding the computing lessons where game playing activities can be used as a teaching and learning method, (2) measuring playtest level gain by playing games for meaningful play in computing education, and (3) analyzing experiences gained by playing games for teaching and learning computing lessons. A qualitative research design was selected to answer three research questions. The study reveals findings from observing a phenomenon without interfering from several case studies which illustrate the process of playtesting activity by a group of participants using multi-model methods. The multi-modal methods consist of a direct observation and interview sessions were used to analyze common experiences gained by playing games for teaching purposes. Analytical results through data interpretation coding was done systematically to identify and categorize specific observable actions or characteristics. The study suggests that game playing activities can become a meaningful and knowledgeable play in education.

Keywords: *game-based learning, game playing, game testing, game user research.*

I. INTRODUCTION

Digital games (or games) are increasingly being used in education to improve academic achievement, motivation, and classroom dynamics (M. Farber. 2015). Games are not only used to teach young school children (Farhana. 2015), but also used to improve the quality of academic performance in university education (P. Turner.2018). The ability to use games as teaching or learning tools requires two-pronged approach, i.e. *learning by playing games* and *learning by creating games*. But for this research, the intention is to investigate the effects of playing games towards learning certain topics or domain in computing field.

Playing games naturally create a compelling complex problem space or world, which players come to understand through self-directed exploration. They are scaffolded to deliver better results in producing better human, i.e. improved hand-eye coordination, producing better surgeons, overcome dyslexia, whole-body-

interaction, slowing the aging process, ease pain, making new social connections, making faster decisions, reduce stress, less likely to bully, and address autism.

By understanding how the gamers play and act towards the gameplay activity, game developers can understand gamers thoroughly before or while designing new games. As mentioned, playing games requires problem solving skills, thinking about level logic, spending hours fixing errors and bugs in programs, and being obsessed with aesthetics, gameplay, game mechanics, performance, playability, and all kinds of details (Mossman. 2017: 164-179). Without a well-developed playing ability, a person may encounter serious problems affecting one's academic pursuit or career.

Therefore, this research study embarks a deep understanding on gamer's experiences (user experiences @ UX) in playing games (playtest @ PT) to narrow any gap exists between playing experiences and learning topics or domain in computing field. As the status of the body of knowledge in game-based learning field, this research will fulfil that gap stated in the literature in the next chapter.

II. MOTIVATION

There are three main reasons derive for the motivation in conducting this study – the usage of games for learning purposes, playing games to improve living skills, and the need for game designers to understand gamers' requirements and need. For these reasons, this research study focuses at a popular game which is called Defense of the Ancients (DOTA2). Since the game is well-accepted in the game industry and have been recognized by game community around the world, this research will use both academic and industry approach for UX testing session.

III. LITERATURE REVIEWS

A. Computational Thinking

As we live in a technology and media-driven environment, marked by access to an abundance of information, rapid changes in technology tools and the ability to collaborate and make individual contributions, one must be able to exhibit a range of functional and critical thinking skills such as information literacy, media literacy, Information, Communications and Technology (ICT) literacy, data interpretation and analysis, and computer programming. Furthermore, the most important

skill a student in this era must have is computational thinking (CT) (Mohanty and Das. 2017: 135–141).

CT is a process of solving problems by thinking about how a computer can help human to create solution for complex problems. In Malaysia curriculum development for secondary schoolers, CT is being taught using straight-forwards concepts and approaches as described in the Standard Document for Curriculum and Assessment (Dokumen Standard Kurikulum dan Pentaksiran @ DSKP) for Basic Science Computer course (Asas Sistem Komputer @ ASK) (Mohanty and Das. 2017: 135–141). Since 2015, the course had been taught for Lower Secondary students and it emphasize on the CT activity.

Four CT techniques were implemented by teachers who are teaching CT in ASK course for Lower Secondary students for solving problems (Kementerian Pendidikan Malaysia, 2015): (1) decomposition, (2) pattern recognition, (3) abstraction, and (4) generalization. The four techniques are shown in Table 2.1. These four techniques will be analyzed and mapped with the game playing activity in this study.

TABLE I. COMPUTATIONAL THINKING TECHNIQUES

CT Techniques	Description
a) Decomposition	The ability to break down a task.
b) Pattern Recognition	Ability to notice similarity or common differences to make predictions.
c) Abstraction	Ability to filter out information that is not necessary to solve a certain time of problem.
d) Generalization	Ability to generalize the information that is necessary.

B. Learning by Playing Games

The tendency of today’s students to spend most of their time with games and computers has made this research believable (Druin. 2013). As mentioned, there are two approaches happen to intertwine in the field of game-based learning. One approach involves with playing games while the other involves with designing or making games (Maizatul Hayati and Laili Farhana. 2014). To gather information that could assist this research, previous efforts in the same direction in several research projects conducted by are taken into consideration.

In recent years, the development of educational games does not only focus on how games can assist students in learning, but focus has also been given in learning more about a specific topic in the curriculum (Y. Kafai. 2015). In addition, (D. Michael and S. Chen. 2010) further elaborate that the benefits of serious games include the ability for students to model complex systems; engage highly with the material; interact when learning; employ constructivist teaching methods and save cost by reducing skill training time in a real-world setting. Current research development has shown that the construction of potential game-based learning can offer many benefits to the learners.

C. UX in Game Study Field

UX is about catering the design of a software to fit the needs of users or end users (M. Resnick and E. Rosenbaum. 2013: 163-181). UX research plays an important part in helping designers to understand user and assess how the designers serve the users’ needs or even discover opportunities to create something even better (Craftsman. 2017). By using UX research methodology and procedures, researchers will find the answers to the most basic questions about the gamers and the game developers involve in this research.

Recent research papers in UX design and practice show increasing numbers of research in games particularly targeting at the gamers/players in experiencing the game (Craftsman. 2017). However, a list of misconceptions about UX were addressed (Wong Seng Yue and S. Ghavifekr. 2013) which not only involve the gamers/players but also the game designers/developers.

One of the misconceptions is UX will distort design intents. It was found that the game developers fear UX will hamper their creativity or just make the game easier. Hence, the main purpose of UX practice is to offer the experience intended to the targeted audience.

D. DOTA2: Defense of the Ancients

DOTA2 is a multiplayer online battle arena (MOBA) game published by Valve Corporation. It has been a game that is well-accepted in the game industry and have been recognized by game community. As a stand-alone sequel to Defense of the Ancients (DotA), DOTA2 was created as a community-created mod for Warcraft3: Reign of Chaos (published by Blizzard Entertainment)..

The evolution of DOTA2 evolves since 2002 which a map-maker in a community created DotA map based on the Starcraft map “Aeon of Strife”. It emerges based on the highly acceptance of players all over the world. Based on MOBA modification of Warcraft III: Reign of Chaos and its expansion, The Frozen Throne, DotA (second instalment) allows players to create their own maps using a map-creation tool build-in in the game. The maps created include various changed aspects from something as simple as terrain changes, to new rules and events. Since then, the game has its competitive mode stabilized, and organized competitions or tournaments emerge (Liquipedia. 2018).

DOTA2 professional and amateur teams or players from around the world will compete in a competitive battle in DOTA2 tournaments. DOTA2 tournaments are divided into two phases: (1) Qualifiers, where teams play against each other to grab a spot at the tournament; and (2) the Main Event, where qualified teams play in either single or double-elimination brackets to become the tournament's champions.

In addition, DOTA2 tournaments can be distributed among three main groups: (1) Premier tournaments, or those which generally include a significant prize pool and LAN Finals broadcasted live; (2) the Minor tournaments, or those which are mostly played online-only by regional

teams with a significantly smaller prize pool; and (3) the Majors tournaments, which are three Valve-sponsored tournaments plus The International, all of which feature huge prize pools, compendiums, merchandise, and more. The tournaments started since 2011 and for 2018, the International 2018 will be held in Vancouver, Canada. Chronology of the tournaments is symbolize using color cycle.

Valve-sponsored tournaments usually include the release of special Immortal items that can only be obtained during the event by buying either the compendium or selected merchandise during the LAN Finals. As of 2015, there is no other game featuring as many tournaments as DOTA2. The game's flagship annual championship (i.e. the International DOTA2 Championship) is the biggest tournament to ever take place in esports or pro gaming. The tournament for 2018 (i.e. eighth iteration of DOTA2's flagship annual championship) will take place in Vancouver, Canada and hosted by Valve.

DOTA2 is played by ten people per game, divided into two teams with five people per team. A player controls their own character, known as a "Hero", a strong character with their own special abilities. Each hero has a set of features that define his role in the team and play style. Among these features, there are three basic attributes (i.e. strength, agility or intelligence) and a unique set of five play styles to be choose from (i.e. fighting, farming, supporting, pushing, and versatility) skills. These features allow each hero to fill several roles in the team, such as "damage dealer" (i.e. hero, whose role is to attack the enemies in the fight), "support" (i.e. hero, who mostly heals and otherwise helps his teammates), "caster" (i.e. hero, who mostly relies on his spells) or others. As of the time of writing, there are 113 selectable heroes to choose from.

Each team begins the game in their own base, which are located in the southwestern and northeastern point of the map. In the bases, there is a monument known as the "Ancient". True to the name of the game, the goal of the players is to defend the ancient from the opposing team, while at the same time trying to destroy their opponent's.

With constant changes to the game like buffs and nerfs and the addition of new heroes, some UX redesigns are required. For example, the controversial 7.00 "The New Journey" update for DOTA2 included a HUD overhaul, maximizing screen space for an increased map view and tweaked UI elements like a simplified mini-map and top bar-integrated teammate status allowing players to absorb in more data in a shorter time frame for processing (O. Alvarez-Xochihua. 2017: 143–150). Other UX changes include a new "pre-game" which allows for new features not previously present, such as planning and buying items. All these UX changes also changes the experience of the game for the players, as they are now more simplified and geared towards usability.

IV. RESEARCH OBJECTIVES

This research aims to investigate the topics or domains where game playing activity can be used as one of a

learning method. It was conducted within the following objectives:

- RO1: To find topics or domains in computing field for learning purposes.
- RO2: To measure PT level gained by playing a game for a meaningful play.
- RO3: To measure UX level gained by playing a game for a meaningful play.

Three research questions were formulated based on the three research objectives, as follows:

- RQ1: In what context does playing a game is useful in learning topics or domains in computing field?
- RQ2: Which PT level gained by playing a game contributes for a meaningful play?
- RQ3: Which UX level gained by playing a game contributes for a meaningful play?

Initially, this research condign itself to observation and interview to analyze common experiences gained by playing games for learning purposes conducted in UPSI with students from a Diploma in Game Design and Development program. In qualitative study, UX findings could be subject to other interpretations. In other words, in this purposive sampling procedure, this study cannot be generalizable to all areas of topics or domains of learning.

V. METHODS AND PROCEDURES

The study follows a qualitative approach which is believed much better suited for in-depth understanding of the users' experiences, motivations, and everyday lives. In other words, a qualitative approach is often more exploratory. Since this research need to be finish within a year, a case study was done with students from one diploma program. In the case study, a total of 63 students (34 students from Semester 2 and 29 students from Semester 4) were enrolled at the time this research was being conducted. Purposive sampling was used to select only ten participants to be involve in this research. Furthermore, purposive sampling is one of the most cost-effective and time-effective sampling methods available

From a total of 63 students, ten students were chosen using a purposive sampling (most cost-effective and time-effective sampling methods available). The students were filtered according the following factors, i.e. number of hours playing DOTA2; their attitude towards game playing; and ability to give constructive opinions and suggestions. The filtering technique used were mainly relies on the researcher own judgement when choosing members of population to participate in the case study. Next, they are divided into two teams to compete playing the game for four hours.

The participants were involved in two forms of data collection which are interview and observation and to analyze common experiences gained by playing games for learning purposes Feedbacks gained were analyzed through coding where researchers commonly interpreted

the findings by searching data systematically to identify and categorize specific observable actions or behaviors.

In the observation session, the participants' gameplay sessions were recorded using video camera. Once the session ended, the footage from the video were being transcribed, analyzed, and mapped with a set of observation checklist. After the interview sessions, the video recorder was verified and analyzed. Observation made during the interview and during the gameplay session were noted. The review session was done after all evidences were gathered and emerged from the interview sessions.

In the interview session, a researcher met with participants one-on-one to discuss in depth what the participant thinks about the topic in the questions given. For this purpose, a set of interview protocol were given to the participants. The interviews technique was chosen mainly because the interviewer can pursue in-depth information around the topic. For this purpose, a standardized open-ended interview was used. This method allows the same open-ended questions to be asked to all interviewees; this approach facilitates faster interviews that can be more easily analyzed and compared. Both instruments, i.e. observation checklist and interview questions have gone through a validity procedure by appointed experts.

VI. RESULTS

The two teams competed each other in a two-game of DOTA2 where one-game allocated almost one hour to play. At the end of session, the participants were interviewed by the researchers and the facilitators using the interview protocol.

A. Findings from the Observation Checklist

The participants were carefully observed while playing DOTA2 by researchers and facilitators by watching video recorded during the gameplay session. Then, the researchers and facilitators used the observation checklist to rate the frequency of each of actions or behaviors identified earlier. As mentioned, the observation checklist was developed by the researchers and was validated by an expert. The appointed expert accumulated and synthesized validity of the instrument according to contemporary views of construct validity. The construct validation was measured using correlation score for each item with the total of score. The correlation score was done using Pearson's Correlation Coefficient analysis. It was found that the correlation score for the construct validation was 0.89. Therefore, the instrument for observation checklist was decided to have good construct validity.

From the instrument (observational checklist), a list of actions or behaviors were listed. For this research, specific observable actions or behaviors were identified and listed in the instrument. These observable behaviors were selected based on the understanding gamers or players in game playing activity. The behaviors were categorized as listed in Table II.

TABLE II. OBSERVABLE BEHAVIORS OR ACTIONS

Category	Behaviors or Actions
Aggressive	Physical abuse (hitting, fighting, teasing, bullying, angry), verbally attack (argue, name calling, teasing, provokes) etc.
Disruptive	Intentionally interrupts (seek attention, do not follow the rules), telling lies (bluffing, lack of honesty, fake) etc.
Uncorporative	Blame on others (argues with team members, criticise others), bossy (not following routines, need to become the center of attention) etc.
Manipulative	Lack of efforts (confused, forgetful, lost), cunning (distracting others, ignoring others) etc.
Unsocialized	Lack of social skills (avoiding discussion, lack of sensitivity), unethical (dishonest, sexual harassment) etc.

The following are the main findings from the observation session:

1) *All participants show signs of aggressiveness while playing DOTA2.* From the observation session done, three from five players from Team 1 (A, B and E) constantly attack their opponents by teasing and provoking them. None of them ever use physical abuse. From Team 2, only two players (G and H) were verbally attack their opponents by teasing them. Again, none of them use any form of physical abuse. The verbal attack used by both teams happened since these two teams were playing opposite each other and not in different location as how a normal multiplayer gamer always done.

1) *All players from Team 1 and all players from Team 2 played fair games.* They do not interrupt each other intentionally. However, they did have a conversation among their team members using headphones and silently talking about their gameplay.

2) *Since the competition is about teamwork, both teams show a good communication and team ethics.* None of them blaming or criticise each other when they lost a game.

2) *Both teams show their efforts in winning the game however, Team 2 was offended since they kept on losing the games.* Team 1 seems to have better experiences in the gameplay of DOTA2. Two players from Team 1 have been participated in the DOTA2 competition in the state region of Sabah and Perak. Team 1 players shows their egos and started to distract and manipulate the other team.

3) *All players from Team 1 and all players from Team 2 shows their skills in socializing in and out of the game environment.* They showed interacting skills with their teammates and with their opponents, taking turns, rule-following, follow directions, and team work.

B. Findings from the Interview Session

In the interview session, a researcher met with participants one-on-one to discuss in depth what the participant thinks about the topic in questions given. For this purpose, a set of interview protocol were given to the participants. A set of interview questions was developed by the researchers and was validated by another group of experts. Again, the construct validation was measured using correlation score for each item with the total of score. The correlation score was done using Pearson's Correlation Coefficient analysis. It was found that the

correlation score for the construct validation was 0.92. Therefore, the instrument for a set of interview questions was decided to have good construct validity. The interviews technique was chosen mainly because the interviewer can pursue in-depth information around the topic.

For this purpose, a standardized open-ended interview was used. The instrument or a prepared script (a set of interview questions) was used to gather data from the ten participants. For the interview session, the participants were asked in terms of: (1) their opinions (i.e. what a person thinks about the topic), and (2) their feelings (i.e. what a person feels rather than what a person thinks). Each category of questions has different concern, as listed in Table III.

TABLE III. CATEGORY OF INTERVIEW QUESTIONS

Category	Questions Description
Opinion (O)	View or judgement about something based on fact, knowledge, experience, or values.
Feeling (F)	An idea or belief that has to do with emotion or affection.

There are ten questions for the interview question session. Five of them falls under opinion (O) and the rest are under the category of feeling (F). Findings from the interview session were mapped with the research questions and objectives in the Chapter 5. However, the following are findings for Question Number 7 (“What other things do you gained by playing DOTA2? (i.e. CT: Decomposition, pattern recognition, abstraction, and generalization)”). To simplify the findings, Table IV shows the relationship between the findings and the four techniques in CT:

TABLE IV. FINDINGS AND THE CT TECHNIQUES

CT	Findings
Decomposition	<ul style="list-style-type: none"> [Observation] All players from both teams show their ability to decompose their gameplay into small part especially in controlling the character they choosed. The possibility to decompose the mission and the gameplay, allows them found a relation between the regularity of the solution and the existing mission. Their behaviours from the gameplay have made it easier to tackle the challenges. [Interview] By identifying a couple of key factors that make them gaining skills by playing DOTA2, the participants positively answered the life skills they gained, i.e. patience (due to repetitive activity), strategic planning (appreciate stiuates planning and strategy in competing the challenges), and social interaction.
Pattern Recognition	<ul style="list-style-type: none"> [Observation] All players from both teams show their ability at tasks which required them to develop strategies for the mission and the gameplay. But results showed that two players from Team 1 and one player from Team 2 made more errors and poorer in their strategy score. [Interview] All players from both teams totally agreed on the important part of pattern recognition in DOTA2 which provides high-level information from the game world to the decision-making system. Selecting DOTA2’s characters to be played is a tough decision and players need to filter from the recognized

CT	Findings
	information of listed character with different personalities before confirming their character selection.
Abstraction	<ul style="list-style-type: none"> [Observation] All players from both teams seems to have difficulties in breaking down their gamelay into a series of action and put these actions in order. For example, eight out of ten participants said that they faced difficulties and confusion in abstract thinking. Since abstract thinking is closely related to the concepts of preserving information that is relevant in a given context and illuminate information that is irrelevant, identify selection of characters in DOTA2 and understanding the selection of characters by others (especially by opponents) are skills to be mastered. [Interview] Based on the feedbacks, according to all participants, there are many ways for them to play DOTA2, either with their own group or random selection in online. If they choose to play with random players, they must depend on luck since they do not know the skills that their members have.
Generalization	<ul style="list-style-type: none"> [Observation] All players from both teams show they ability in generalizing the information gained and deployed in their gameplay. [Interview] All players from both teams agreed that CT skills can be develop through gameplay of DOTA2. It helps them to articulate more thinking skills compared to studying. One of the participants believed that before playing DOTA2, watching DOTA2 gameplay video and reading article on DOTA2, can increase his gameplay.

VII. DISCUSSION AND FUTURE SUGGESTION

This section will describe the combination outcomes from the observation and interview sessions done with ten participants. The aim is not to compare or to disseminate data but to gain data to answer the research questions listed. The following are the main outcomes based on the research questions:

1) *RQ1: In what context does playing a game is useful in learning topics or domains in computing field?*

Since the participants were involved in the interviews session, the interview protocol was able to elicit the natural responses. The participants were asked to explain their opinion on learning by playing DOTA2. All participants gave two primary topics or domains in computing field. Firstly, it has to do with programming where DOTA2 players often face with skills such as making decisions and solving problems. One of participant stated that he remembered the skills of making decisions and solving problems were always be taught in programming classes. As a reason that the usefulness of playing DOTA2 has helped generate positive experience of the participants in understanding ultimate skills in programming and algorithms which includes making decisions and solving problems.

Secondly, playing DOTA2 helps them gaining confidence to converse in English. One of the participant stated that “I want to learn English while playthrough DOTA2”. Another stated that communication is important in DOTA2 and the popularity of DOTA2 helps them to

reponses to discussion questions on public forms, understanding generated characters' biography, and the in-game player can generate communication in DOTA2.

Two primary topics or domains in computing field were concerned for learning purposes while playing DOTA2. Firstly, algorithms and programming. Algorithm is a step-by-step set of operations to be performed to solve specific problems (i.e. just like a recipe). Two skills need to master by any programmers or those who wants to involve with algorithmic coding problems in a programming language: (1) decision making, and (2) problem solving. From the observation and interview session, following with the skills of decision making and problem solving, four techniques of CT are also skills to be considered while playing games: (1) decomposition, (2) pattern recognition, (3) abstraction, and (4) generalization.

Secondly, learning the four basic language skills. In DOTA2, players need to address these four skills using English language (on English server) while playing the game: (1) listening – ability to understand what another player is saying or be able to take commands, (2) speaking – ability to speak in a same language to avoid communication problems, (3) reading – ability to see and understand the spoken language depicted symbolically in print such as in a combat log, and (4) writing – ability to reproduce symbolically texts and numeric alphabet.

2) RQ2: Which PT level gained by playing a game contributes for a meaningful play?

All participants provided a variety of other explanation for their answers. In the case study, ten participants were asked to play DOTA2 and PT the DOTA in a form of competition. All participants achieved a high level of PT with 82% or higher accuracy for gameplay that were successful more than three times especially during social interactions with the characters. Majority of the participants interviewed do repeat exercises to achieve their goals, learn from the mistakes they have done, and learn on how to work in a team.

MOBA games including DOTA2 has a large community in the online gaming world which have something special about its gameplay that makes it excite to play. In this research, participants provided a variety of other explanation in terms of playtest. Playtest in this research involved with a group of players playing DOTA2 with the purposes for gathering feedbacks. Another philosophy of playtest involves with exposing a game in development to identify flaws or bugs. But, this is not the case for this research.

3) RQ3: Which UX level gained by playing a game contributes for a meaningful play?

All participants agreed that to play DOTA2, they must have experiences in the gameplay. Majority stated that they started playing since 2015 and were attracted to the characters, maps, and the pattern of the game. All participants stated that they were the game was introduced

by their peers when they entered UPSI. All participants reported that they have spent a minimum of 30 minutes to two hours in the game since they started playing. One participant who spent up to 10,000 thousand hours since he started playing. Meanwhile, six participants who played DOTA2 spent 2 years to 10 years.

MOBA games is not for those who are easily offended. It is common for a form or racism, sexism, or bullying activities in DOTA2. However, for this research, these behaviors were not portrayed by the participants mainly because several factors: (1) they know each other, (2) they were playing in the same location; and (3) they were being watched by the researchers/facilitators. As they become experience players, those who played DOTA2 became more eager and earnest because of the rewards awarded to them. Furthermore, as experienced players, playing DOTA2 make them more critical and creative in their gameplay which increase their self-esteem and self-confidence.

This research is about the impacts of game technology towards ways of learning, i.e. learning by playing DOTA2. Furthermore, the research addresses recommendation and possible future works:

- The possibilities of DOTA2 in inspiring players to learn languages. There are lots of discussion regarding the usage of English language as the medium of instruction and communication throughout playing the game. In one aspect, trying to communicate with team members using different language (e.g. Spanish or Russian) makes it necessary to learn new words and help others learning or even improving their linguistic skills through playing DOTA2.
- Expanding the research using different approaches. As mentioned, only ten participants involved with this research and they were divided into two teams. Both teams were facing each other in a lab where the competitions were held. It is recommended for future research the participants should be allocated in different location (remote) but playing DOTA2 at the same time (synchronous).
- Experience matters. It is emphasized that the longer the gameplay of DOTA2, the more experience the player will gain (level of familiarity). In fact, experience also allows DOTA2' characters (heroes) to level up which eventually make them stronger and allows them to learn new abilities (as rewards and game progression).

VIII. CONCLUSION

Combination outcomes from the observation and interview sessions in this study shows the that game playing activities can become a meaningful and knowledgeable play in education. In this context, game playing activities can be treated as a transformative teaching and learning delivery approach for the 21st century education. In addition, educators should be knowledgeable on the pedagogical knowledge or game-

based learning and familiar with engaging students actively in game-based learning activities.

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