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Impact of GBL on Student Performance and Learning Behaviour : Experience in UiTM Melaka

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Abstract: Computer integrated system has commonly used to increase classroom engagement by educators in schools and universities. It is to enhance students' learning interest toward studies and improve their academic result which relates to weakness of the traditional based learning process. Moving towards the 21th century, education environment has also introduced with Game-Based Learning (GBL) used to encourage students to participate in learning, while having fun and creating more interesting learning process. As an interactive learning setting, GBL provides an opportunity for the teaching process to evolve through the incorporation of game elements. GBL is suggested able to capture students' attention, motivation towards goals, promote competition, effective teamwork and improve communication. This study investigates the effectiveness of a game-based learning program adapted from a television show known as 'Who Wants To Be A Millionaire?' to assess students' academic performance. It compares students' performance before and after the game was introduced in the learning process. Through the intertwining of learning, game and computer usage, this study shows that GBL able to increase understandability, interest, result performance and enjoyment (fun) towards the subject. Therefore, it is suggested that current educational framework should seriously adopted GBL as it provides important elements of the 21st century skill of digital literacy, critical thinking and problem-solving criteria to help our students thrive in today's world.

Keywords: *Game-Based Learning, Learning process, 21th Century Learning*

INTRODUCTION

In the era of 21st century, the way of learning has evolved tremendously. Modern teaching aids are important and most preferred in the technological age. One of the most curret educational method use in teaching is Game-based learning (GBL) that uses technology to impart education (Barzilai & Blau, 2014; Cheng & Su, 2012). GBL refers as a game play that has learning outcomes and designed to balance subject matter with the ability of the player to retain and apply the subject matter to the real world. It involves competition, even if the competition is with oneself. It has goals, constraints, payoffs, consequences and rule-guided (Al-Azawi, Al-Faliti, & Al-Blushi, 2016). Through GBL, the learning process is easy, more interesting and and provide a creative platform to the students (Cheng & Su, 2012).

GBL borrows certain gaming principles and applying them to real-life settings in order to improve users' participation. It is not just creating games to play, but it also involve learning activities that can progressively introduce concepts and guide students towards the learning outcome. The motivational psychology embedded in GBL allows students to adopt the developed educational materials in a playful and dynamic way. Game is defines as a system that involve interaction with a user interface to generate visual feedback on a computer or a video device to utilize fun, play and competition (Shabanah, Chen, Wechsler, Darr & Wegman, 2010). Fun is created in a game when a player able to achieve the goal of the game, feeling intellectual and aesthetic with something which is unpredictible, being challenges to solve dificult problem and feeling honor when they won the game (Takaoka, Okamoto & Shimokawa, 2011).

It is very important for learning process to have the fun element. Research in neuroimaging and neurochemical suggest that 'superior learning' takes place when classroom experiences are enjoyable and relevant to the students' lives, interest and experience (Pawlak, Magarinos, Melchor, McEwan, & Strickland, 2003). This is supported by education theorist that suggests most students retain what they have learnt when they have strong emotion (Dulay & Burt, 1977). In contrast, stress, boredom, confusion, low motivation and anxiety can interfere the effectiveness of student's learning process (Christianson, 1992). Fun learning environment contributes by active learning experience where the students are energeticly doing thing and at

the same time thinking about the activities that they involves in.

Sung, Hwang, Lin and Hong (2017) asserted that experiential game-based learning approach will not only help the students to broaden their knowledge acquisition but also increase students' motivation in learning process. It is supported by Cheng and Su (2012) which found that learning interest and motivations have significant impact on learning achievements by students who are engaged by game-based learning rather than students who were using face-to-face teaching method. Since strategic games improve the functioning of brain, it creates a dynamic that can inspire learners to develop skills and build an emotional connection to learning and subject matter. Other study also suggests that GBL can provide an effective way to motivating learning experiences that would increase student interest in the respective areas and improve student academic performance (Barzilai & Blau, 2014).

One of the most important contribution of GBL is, it helps the students to understand the meaning of learning, which will lead them to be a life long learners with positive attitude (Sung et al., 2017). This philosophy toward more active learning suggests that the aim of teaching is not to transmit information but to transform students from passive recipients of other people's knowledge into active constructors of their own and others' knowledge (Ellerman, 1999). The knowledge and skills acquired through game-based learning are retained longer than information from other learning methods.

Chow (2013) suggests, adaptability and non-linearity are prominent directions in today's pedagogy and are more efficiently achieved in GBL. This is because educational games can be dynamically adjusted according to the learner's interaction and performance. While goalbased learning, which is prominent in nonlinear pedagogy, can be introduced as the goal of the game. A gameplay- based structure of the learning process has been proven to engage learners to accomplish learning goals. Cheng, Lin, She & Kuo (2016) opined that GBL able to facilitated student science learning achievement since it is often believed to have the potential in facilitating both the cognitive and affective/motivational processes of learning. Yien, Hung, Hwang and Lin (2011) studies on the impact of using game-based learning on nutrition students. The study reveals positive attitudes towards using game-based learning hence improve their learning achievements.

Qian (2016) asserted that GBL approach able to facilitate 21st century skills acquisition among students. The 21th century skills refers to wide range of skills such as lifelong learning, innovation skills (communication, critical thinking, problem solving, creativity), information and technology skill (Binkley et al., 2010). Therefore, GBL requires people to be critical thinker, creative and internet savvy. Thus, it provides room for the students to develop their skills and increase their motivation in learning. Game-based learning also plays important role in teaching by making students to collaborate, communicate, interact and work in teams (Korman & Johnston, 2013). A good design of a GBL should engage the students, promote meaningful learning, increase self-interaction and enhance student motivation (Qian & Clark, 2016; Tan, Goh, Ang, & Huan, 2016). In addition, game-based learning helps the students to understand the meaning of learning, which will lead them to be a life long learners with positive attitude (Sung et al., 2017).

Beside the above discussion, GBL is also in line with the 21th generation's way of learning as they are reported to spend more times playing games either digital or online. Based on Statista Research Department on 27 September 2018, the number of hours spent by Malaysian teenager on playing video or computer games is increasing since year 2016. By accomodating GBL in their learning process, it

will evoke in players' experience of flow and positive emotions and reduce their addiction to non- academic games besides creating a new learning culture that corresponds better with students' habit and interest.

Table 1. Percentage of hours spend on video or computer games by Malaysian teenagers

Hours spend	2016	2017	2018
Less than 1 hour	14.1%	14.08%	13.63%
1 to 3 hours	29.62%	29.17%	31.09%
4 to 10 hours	21.56%	22.41%	24.88%

Beside introducing fun in learning process, GBL also helps to improve remedial students with difficulties in learning due to lack of interest, lack of self-confidence or having negative attitudes towards learning. This proposed for the need to pay more attention to individual differences among students as some of them might learn better in GBL environment. Introduction of GBL also triggers creativity among educators to match their student learning

styles and reduce their burden in assessing their student's performance as the scores can be automatically assessed by the digital games.

METHODOLOGY

Thus, sociocultural learning theory (Vygotsky, 1978) could be incorporated in designing a meaningful game-based learning. Learning takes place when it is active, social and situated (Vygotsky, 1978). Play is important in learning as the students able to have play experiences which farther stretch their conceptual abilities and knowledge. Vygotsky's sociocultural theory of human learning describes learning as a social process and the origination of human intelligence in society or culture. The major theme of Vygotsky's theoretical framework is that social interaction plays a fundamental role in the development of cognition. Vygotsky believed everything is learned on two levels. First, through interaction with others, and then integrated into the individual's mental structure. A second aspect of Vygotsky's theory is the idea that the potential for cognitive development is limited to a "zone of proximal development" (ZPD). This "zone" is the area of exploration for which the student is cognitively prepared, but requires help and social interaction to fully develop. Therefore, game-based learning could provide incredible, realistic immersive learning environments.

In line with Vygotsky's theory, research design of this study consists of pre and post experiment on two groups of student. Experimental methods are commonly used in the cases of empirical studies conducted in educational settings. They are used to investigate the potential impact of educational innovations, in which observation of interactions between learners and the innovations takes place within the classroom environment.

With GBL program adapted from a television show known as 'Who Want To Be A Millionaire' (WWTBAM), this study attempt to probe the effect of GBL towards students' learning behaviour and performance. The game contains 150 multiple choice questions and challenge the student to be the richest player by granting them with different amount of money-point as the rewards of their achievement. Questions are divided into three levels of difficulties consisting 50 questions in each level with increasing rewards. In each level, the students will be tested with 15 questions which will be randomly selected by the computer. Once they fail any level, they will

have to play the game from the beginning with different set of randomly selected questions. The students also provided with lifeline (talian hayat) to assist them in winning the game. Students with the highest score of money-points and shortest time taken to answer all the question correctly will be the winner of the game.

The study was conducted on two different groups of student. The first group was students from the Faculty of Computer Science and Mathematics enrolling in CS134 course in Jun 2013 – November 2013. They were introduced with WWTBAM during their learning process of the semester and encouraged to play the game in group setting to promote communication. Their examination result will then compared with the previous semester's examination result (Dec 2012 – Mac 2013) of the same course. The second group experimenting WWTBAM was a group 50 students of the Majlis Perwakilan Pelajar (MPP) in Dec 2016 – Mac 2017 undergoing a leadership training program organised by the Office of Students Affairs, UiTM Melaka. New sets of questions regarding leadership skills and UiTM policies were developed and gathered into the game database. The training program were also re- constructed using the GBL approach. Their knowledge and leadership skills were then compared to previous group of MPP's students who underwent the same training program.

The interfaces and stages of the GBL were explained and presented in the following figures:

Fig. 1 Qualifying phase of Who Wants to be a Millionaire

The above figure represent the initialising or the entrance phase of the game. The students will need to answer the question correctly before they are qualified to joint the game. Random questions will be selected by the program and students are allowed to repeat their attempts.
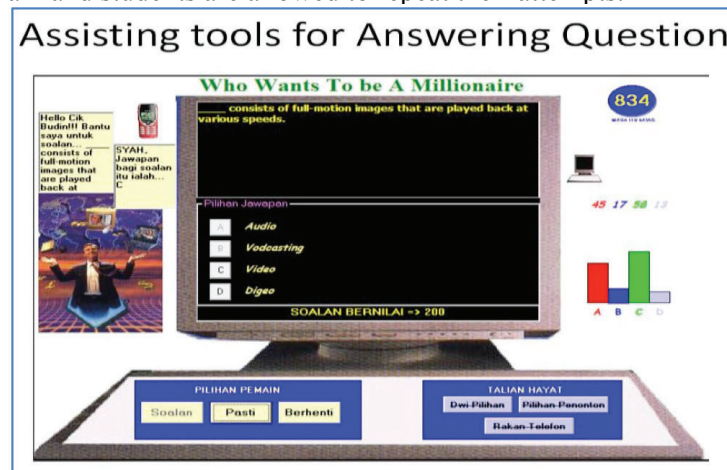

Fig. 2 First level difficulties (RM100)

The first level of the game offer RM100 money-point if the student managed to answer it correctly. Correct answer of the first level will entitle them to compete in the first level until they managed to win RM1,000 money-point as the biggest reward to qualify them to enter into the second level of the game.
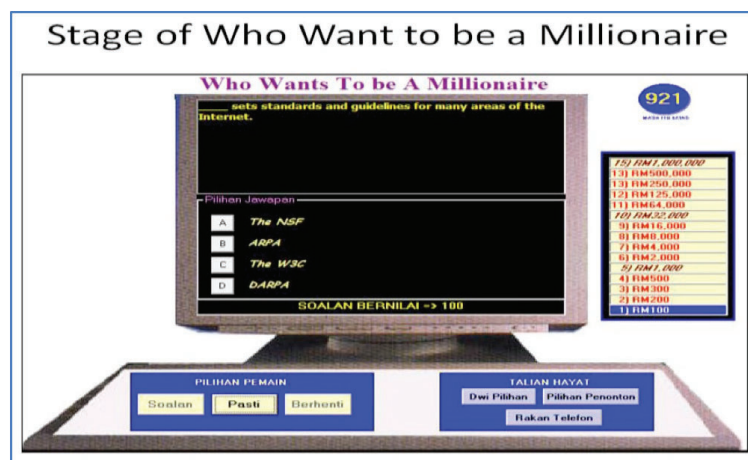

Fig. 3 Lifeline Interface

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The game also provide an active interaction during the game session. Three lifelines is provided where students are allowed to used it when necessary. The options of lifeline are (i) two-option choice
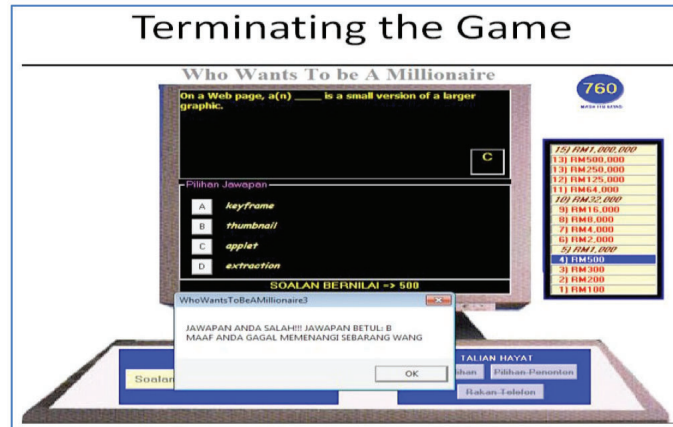(ii) audience's choice and (iii) friends.

Fig. 3 Game Termination

If the student fails to answer the question correctly and used all the lifelines provided, they will be terminated from the game. Students will only allowed to maintain the money-point earned once they managed to pass the first level of the game. In order to re-joint, the student will need to register as a new player and repeat the qualifying phase again.

Fig. 4 Player Ranking Interface

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Once the student successfully accomplished the game with the shortest time, their name will be listed at the top of the Player Ranking Interface. Other students will need to challenge the time ranked in order to be the next winner or the richest player of the WWTBAM game.

RESULTS AND DISCUSSION

i) Students enrolling CS134 course

The analysis of the previous examination result of CS134 (Dec 2012 – Mac 2013) shows a low percentage of students that able to answer the multiple question correctly since they are unable to thoroughly read the question and found it very technical besides having only ¼ chance to answer it right. With the introduction of WWTBAM during the semester, analysis on the tested group's result shows that percentage of students managed to pass the multiple session question has increased by 70%. In addition to their examination result, a survey on the effectiveness of WWTBAM was conducted. The following tables shows students' perception on the effect of WWTBAM game-based learning program towards their learning behaviour.

Table 2. Survey on Learning Behaviour (post experiment)

	Yes	No
Increase in performance	62%	38%
Understandability	82.7%	17.3%
Having fun	80%	20%
Increase interest	80%	20%

ii) Student Leader Group (MPP)

Based on the same method of pre and post experiment, WWTBAM game-based program was introduced and conducted only on student leader group in Dec 2016 – Mac 2017. Prior semester's student leaders' knowledge and leadership skill were measured and reported at less than 50%. With GBL game-based program of WWTBAM, the new student leaders' knowledge and leadership performance has increased to 100%.

CONCLUSION

Based on the result of the pre and post of the study, it shows that GBL has managed to increase students' performance on the subject taught as it able to improve cognitive skills, mental mapping and positive behaviour among students (Michael & Chen, 2017). Students were found to participate in two ways during the game: (i) by accommodating their own behaviour during the conveyance of the learning content and (ii) capturing affective learner behaviour when interacting with the content (Tsatsou, Vretos & Daras, 2019). The findings also suggest that GBL can also be an effective approach to develop leadership skills as it promote motivation skill, facilitation, coaching, mind-set changing, and communication.

As GBL method promotes positive attitudes especially among the 21th century, more studies should be conducted to access how game-based learning could enable students to develop certain useful skills and competencies; communication, resourcefulness and adaptability skills. These attributes are important and crucial for them to apply in the future workforce. Such skills are referred as 'graduate attributes' and are generally associated with the employability of higher education graduates.

REFERENCES

Al-Azawi, R., Al-Faliti, F., & Al-Blushi, M. (2016). Educational gamification vs. game based learning: Comparative study. International Journal of Innovation, Management and Technology, 7(4), 132-136

Barzilai, S., & Blau, I. (2014). Scaffolding game-based learning: Impact on learning achievements, perceived learning, and game experiences. Computers & Education, 70, 65-79. doi:https://doi.org/10.1016/j.compedu.2013.08.003

Binkley, M., Erstad, O., Herman, J., Raizen, S., Ripley, M., & Rumble, M. (2010). Draft white paper 1: Defining 21st century skills. Available online also at: http://cms. education. gov. il/NR/rdonlyres/19B97225-84B1-4259-B423- 4698E1E8171A/115804/defining21stcenturyskills. pdf [accessed in Kota Kinabalu, Malaysia: April 15, 2015].

Cheng, C.-H., & Su, C.-H. (2012). A Game-based learning system for improving student's learning effectiveness in system analysis course. Procedia - Social and Behavioral Sciences, 31, 669-675. doi:https://doi.org/10.1016/j.sbspro.2011.12.122

Cheng, M.-T., Lin, Y.-W., She, H. C., & Kuo, P. C. (2016). Is immersion of any value? Whether, and to what extent, game immersion experience during serious gaming effects science learning. British Journal of Educational Technology, 48(2), 246- 263.

Chow, J. Y. (2013). "Nonlinear learning underpinning pedagogy: evidence challenges and implications", Quest, vol. 65, no. 4, pp. 469-484.

Christianson, S.A. (1992). Emotional stress and eyewitness memory: A critical review. Psychological Bulletin, 112(2), 284–309.

Dulay, H., & Burt, M. (1977). Remarks on creativity in language acquisition. In M. Burt, H. Dulay, & M. Finocchiaro (Eds.), Viewpoints on English as a second language. New York: Regents.

Ellerman, D.P (1999). Global Institutions: Transforming International Development Agencies into Learning Organizations. The Academy of Management Executive (1993-2005), Vol. 13, No. 1, Global Competetiveness. Part II (Feb., 1999), pp. 25-35

Korman, T. M., & Johnston, H. (2013, 23-26 Oct. 2013). Using game-based learning and simulations to enhance engineering and management education. Paper presented at the 2013 IEEE Frontiers in Education Conference (FIE).

Michael, D. R., & Chen, S. L. (2005). Serious games: Games that educate, train, and inform. [Electronic version]. Publisher: Muska & Lipman/Premier-Trade. Retrieved June 11, 2017, from http://0-site.ebrary.com.aupac.lib.athabascau.ca/lib/athabasca/edf.action?p00=&docID=1008 7000&page=10.

Pawlak, R., Magarinos, A. M., Melchor, J., McEwen, B., & Strickland, S. (2003). Tissue plasminogen activator in the amygdala is critical for stress-induced anxietylike behavior. Nature Neuroscience, 6(2), 168–174.

Qian, M., & Clark, K. R. (2016). Game-based Learning and 21st century skills: A review of recent research. Computers in Human Behavior, 63, 50-58.doi:https://doi.org/10.1016/j.chb.2016.05.023

Shabanah, S. S., J. X. Chen, J. X., Wechsler. H, Carr. D., and Wegman., E. (2010). "Designing computer games to teach algorithms," in Proc. 2010 Seventh International Conference on Information Technology: New Generations, 2010, pp. 1119–1126.

Sung, H.-Y., Hwang, G.-J., Lin, C.-J., & Hong, T.-W. (2017). Experiencing the Analects of Confucius: An experiential game-based learning approach to promoting students' motivation and conception of learning. Computers & Education, 110, 143-153. doi:https://doi.org/10.1016/j.compedu.2017.03.014

Tan, J. L., Goh, D. H.-L., Ang, R. P., & Huan, V. S. (2016). Learning efficacy and user acceptance of a game-based social skills learning environment. International Journal of Child-Computer Interaction, 9-10, 1-19. doi:https://doi.org/10.1016/j.ijcci.2016.09.001

Takaoka, R., Okamoto. T., and M. Shimokawa. (2011)."A framework of edu- cational control in game- based learning environment," in Proc. the 2011 11th IEEE International Conference on Advanced Learning Technologies, ICALT 2011, pp. 32–36, 2011.

Tsatsou, D., Vretos, N. & Daras, P. Journal of Computer Education (2019) 6: 215. https://doi.org/10.1007/s40692-018-0118-9

Vygotsky, L. S. (1978). Mind in Society: The develeopment of higher mental process. Cambridge, MA: Harvard University Press.

Yien, J.-M., Hung, C.-M., Hwang, G.-J., & Lin, Y.-C. (2011). A game-based learning approach to improving students' learning achievements in a Nutrition course. Turkish Online Journal of Educational Technology-TOJET, 10(2), 1-10