

A SURVEY ANALYSIS: STUDENTS' PERCEPTIONS OF USING SIMULATION GAME AS LEARNING TOOL

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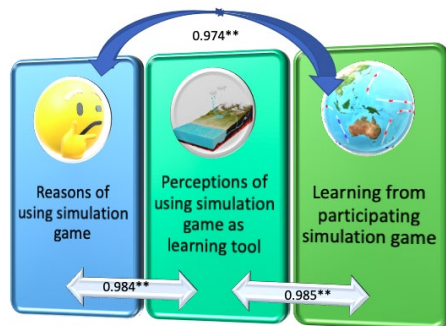
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Graphical abstract



Abstract

The potential use and effectiveness of simulation games for learning purposes have heavily drawn on human cognition or information processing theories. Lack of acceptance and study on simulation games as learning tool in higher education offer this opportunity to conduct a survey analysis on students' perceptions on how to utilize simulation game as learning tool in higher education. This paper discusses the findings of the survey that was carried out with an objective to examine quality of simulation games meant for learning in higher education institutions. Respondents in the survey were students from a local university. Quantitative data was collected with the survey questionnaires. Finally, the analysis results uncovered to what extend students differ in their perception of participating simulation games and attitudes towards utilizing simulation games as learning tool. The survey results have shown most of the respondents agree and give positive responds on utilization simulation games as learning tool in higher education institution. Students' perceptions (simulation as valid presentation, apply relevant theoretical knowledge to the game, and ease of use interface) also have shown their predictive effect in their learning from the participation of simulation game, with the variances 97.7%. Students also shown their strong confident that they satisfied the benefits and learning from participating in the simulation game. Simulation games are recommended as learning tool in higher education from the overall students' perceptions in the survey.

Keywords: Higher education, learning tool, perceptions, simulation games, survey

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1.0 INTRODUCTION

The potential of games to engage students and to support learning has been widely acknowledged by educational practitioners and by now, a broad range of studies has been proven the effective use of digital games or computer games in all stages of formal education [1]. The latest trend shows that educational games, simulation games, serious games and entertainment digital games offer great opportunities to appropriate practice [2]. Moreover, the trend also proved that educational games have crucial impact on learning process [3], higher level cognitive development, critical thinking and strengthening motivation [3, 4, 5, 6, 7, 8, 9] and learning competencies [10] among learners. The students are pyramidally attaining knowledge and skills indirectly as nowadays many mobile applications are relating to educational

requirements and training needs [1], named gamification. Indeed, the interactive gamification environment can merge with the efficient problem-solving episodes with immersive learning experience for students [1]. The scholar also examined students' perceptions of gaming as an experiential learning tool and found that students have learned and have fun when there is gaming in their classroom activities [11].

Video or simulation games have become a mainstream of leisure life worldwide for the past two decades. The potential use and effectiveness of simulation games for learning purposes have heavily drawn on human cognition or information processing theories due to the interactive and multimodal features in most computer-based games [12]. Computer games always offer exciting and active ways for students to learn, both formally and within the boundaries of formal education. However, when it comes to a formal

learning, there is a problem exists with finding and utilizing appropriate games, or games appropriately [13]. Furthermore, yet the research specifically examines the effectiveness of simulation games for language learning remains scarce [12]. Simulation games are one of the suitable tools to fit in the student-centred learning approach whereas it provides a substantial self-learning environment besides entertain students [14]. Students can visualize and understand difficult subjects, such as programming learning via simulation games. Students also can interact with the game and receive the feedback or response immediately.

Simulation game can be defined as a game which comprises a combination of skill, opportunity and strategy to simulate a component of reality [15]. From another study by de Smale, Overmans, Jeuring, and de Grint [16], simulation games can be computer-based, non-computer-based or a hybrid version of both types. They claimed that simulation games are used as training to enhance the performance in completing certain tasks and modelling some objects. Some studies also stated that games as learning environment are inseparably related to simulations, microworlds, adventures and case studies [17]. Simulation games are also modelled after a natural or human-made environment, in which players have to obtain pre-specified goals [18].

The prior studies shown the increasing the problem-solving skills by using simulations games [17]. In simulation games, students or players are required to think of solutions and strategies for challenges given in the simulation game tasks. They need to adopt their knowledge, skills, strategies as they are assigned as different game role or character while they are playing the simulation games. In other words, they will strive to solve multiple tasks or series of problems that created in the game. To achieve their game goals, they have to perform all types of actions, and decide the specific decision. Indirectly, simulation games provide a broad range of learning benefits and improve students learning, as well as enhance their soft skills in managing multiple tasks [17]. Furthermore, simulation games are effective in enhancing students learning. Students are more likely to remember the teaching contents from simulation games environment than typical classroom teaching [19]. They are also engaged in their study with the realistic experience in simulation world if compared to the static textbook contents in other study [20]. They felt challenge and motivated to learn.

Application of games in distance learning raises the quality of education and student satisfaction on a higher level, however, the focus is moved from learning domain to different context of the game, including achieve fun and learn at the same time [21]. Another issue is educators feel difficult to track and analyse students learning progress during gaming session, which is vital to give immediate respond and assist students to achieve learning goals [21]. The integrating digital games with formal education need more rigorous baseline studies to map the different uses of games and measure their effectiveness. Concrete real-time analytic tool is required to such a specific learning environment.

One of the most notably problem is lack of acceptance that games as learning tools among the majority of teachers and also many students; games tend to be perceived as a leisure time activity with no pedagogic value [22]. Notwithstanding, the prior qualitative study analysis have indicated simulation and/or games have a positive impact on learning outcomes

[18]. With the significant potential of new innovative technological tools for learning, simulation games are one of the tools have shown its impacts on student performance, engagement and learning motivation [18]. However, there remains a gap on how efficiently incorporate the simulation games in students learning process. Furthermore, Science, Technology, Engineering and Mathematics (STEM) education needs more interactive and interesting technological tools to increase the understanding STEM concepts [23]. There is a lack of motivation and interest in science and mathematics learning [24], and the enrolment of science stream is remained low, with the decline numbers of students in selecting STEM subjects learning [25]. This issue may have negative impacts or implications for a developing country, which need high competent students in problem-solving skills and high level of thinking skills [26]. These issues are highlighted and often related to the lack of interest and motivation to learn STEM and perceived STEM as difficult subjects, and hard to score it well. Thus, simulation games for STEM education has high potential in enhancing and empowering students' 21st century skills and it is great to be utilized to increase STEM learning, develop skills and increase memorization and better understanding of STEM [23]. In this light of the issue, quantitative survey study is needed to quantify students' perception and acceptance simulation game as learning tool, especially for STEM learning. Although recent surveys show that this perception is about to change, people's deeply rooted preconception of videogames as entertainment may mitigate educators' willingness to use them [4, 27, 28].

Thus, the aim of this survey is specifically to examine students' perception and acceptance on how to utilize simulation games as learning tool and what extend simulation games satisfied and benefited students when they are playing simulation games. At the same time, this study also investigate which perception has predictive effect on their learning via simulation game. Furthermore, this paper aims to address the following questions:

1. Why students play simulation games?
2. What are the perceptions of students regarding simulation games?
3. Is there any significant satisfaction from students with the use of simulation games in promoting learning?
4. What are the students' perceptions of simulation game as learning tool in predicting their learning via simulation game?

2.0 METHODOLOGY

This survey analysis was aimed to investigate the students' reasons to play simulation game, perceptions on simulation games as a learning tool, satisfaction with the use of simulation games in promoting their learning, and their perceptions in predicting their learning via simulation game. Simulation games are perceived as a learning tool for STEM learning is vital to stimulate young students' interest in STEM as a future career from their early age of studying. In general, simulation games are the combination of games and simulations, a hybrid products of games and simulations, which consisted of game goals, without end-goal oriented, can re-enact some activities like driving, flying, as well as real world communities,

institutions, and governments, and even a specific system or process to improve performance, productivity and efficiency of some learning modules [16]. For example, flight game (FlightGear Flight Simulator), car modelling (Virtual Construction Simulator) [16], Interactive Simulations for Science and Math (PhET interactive simulations website) [29].

There are forty-two students from a local higher education institution participated in this survey. Subjective data was collected via survey questionnaires. Students received a short briefing about the free portal (PhET Interactive Simulations), purpose of this study, importance of STEM learning, and benefits of simulation games in STEM learning. Students started to explore the simulation games after briefing and they have been explored to experience educational simulation games (STEM simulation games) for two hours per day for one week. A free portal, named PhET Interactive Simulations has created free interactive science and mathematics simulation games to engage students in STEM learning via intuitive and game environment (<https://phet.colorado.edu>). This portal is developed by University of Colorado Boulder, consisted of 161 interactive simulations for physics, chemistry, mathematics, earth science, and biology subjects. After the students enjoy playing simulation games, they answered all the questions in the questionnaires.

The instrument was modified from the previous study [30]. The questionnaires comprised two parts. First part of the questionnaires consisted of open and close ended questions which were aimed to determine participants' demographic, interest of knowledge, most professional field that they are experienced in, previous knowledge in simulation games and the reasons they used simulation games. Second part of the questionnaires were regarding participants' overall perceptions regarding simulation game, perceptions regarding overall degree of involvement in the simulation games, learning and social learning from participating in the simulation games, as well as perceptions of simulation games as a recommended tool for future use. The benefits of simulation games and students' satisfaction on simulation games experience were investigated too. All close ended questions were rated on a 7-point Likert scale ranging from 1 to 7 (1-Strongly Agree; 2-Agree; 3-Somewhat Agree; 4-Neither Agree nor Disagree; 5-Somewhat Disagree; 6-Disagree; 7-Strongly Disagree).

All gathered data were analyzed by using Statistical Package for the Social Science (SPSS) software. The descriptive and frequency analysis was used to answer the research question 1 to 3. Correlation and regression analysis were used to answer research question 4. Table 1 has listed all tested items in the questionnaire according to three dimensions, which are reasons of using simulation games, perceptions on using simulation games as learning tool, and learning from participating the simulation games.

For the multiple regression analysis, dependent variable is students' learning from participating simulation game. Whereas 'recreation of the programming environment', 'covering essential elements in managing learning', 'provision the possibility to apply relevant theoretical knowledge', 'valid presentation of reality to acquire applicable knowledge', and 'ease of use for the user interface' are entered as the predictive variables to represent the students' perceptions regarding the simulation game.

Table 1 Information About the Tested Items for Reasons of Using Simulation Games, Students' Perceptions of Using Simulation Games as Learning Tool, and Students' Learning from Participating Simulation Game

Dimension	Number of Items	Tested Items
Reasons of using simulation game	3	R1: I used simulation games because they are part of the course curriculum R2: I used simulation games because I expected they would raise my interest for the course subject R3: I used simulation games because I expected they would involve me more in the course compared to a regular teaching lecture.
Perceptions on using simulation games as learning tool	5	P1: The simulation game realistic recreates the programming environment P2: The simulation game covers the essential elements in managing learning within a competitive environment P3: The simulation game environment provide you with the possibility to apply relevant theoretical knowledge to the game P4: I view the simulation as a valid representation of reality to acquire applicable knowledge P5: I perceive the user-interface as easy to use (user-friendly)
Learning from participating the simulation games	7	L1: The strategic decisions taken by my group had the forecasted effects in the simulation game L2: The simulation game enabled me to apply relevant theories and models from the curriculum to a practical scenario L3: Playing the simulation game demanded more effort than I usually expect from a course L4: The simulation game engaged me more in the course than a regular teaching method does L5: The simulation game was a good tool to test my decision-making ability L6: The simulation game was a good tool to test my analytical skills L7: The simulation game provided me with knowledge that I can apply in learning in real life

3.0 RESULTS AND DISCUSSION

The questionnaires have been subjected to quantitative analysis and descriptive statistics, figures and the tabulation of data will be used. There are 42 students (33 male, 9 female) who are enrolled computing foundation course in a private university have participated the study. These participants were in age of higher education level. Most of the students' interests of knowledge are Information Technology, 28 students of 42 students. Of 42 students, 54.8% students have most professional experience in engineering and technology, for example Information Technology. Their previous knowledge in

simulation game is very little. 40.5% students have never use simulation games in an educational environment previously and 73.8% students have never use simulation games in a professional environment. The results indicate that there are 26 students (61.9%) from somewhat agree to strongly agree that they used simulation games because they are part of the course curriculum. Next, 57.2% students from somewhat agree to strongly agree that they used simulation games because they expected they would raise their interest for the course subject. 52.4% students from somewhat agree to strongly agree that they used simulation games because they expected they would involve them more in the course if compared to a regular lecture. The results have proved that they have a strong confident to use simulation game because they expect it helps to improve their learning and increase their interest to study the subject.

Besides that, majority of the students (85.7%) with high frequency, from somewhat agree to strongly agree that the simulation game covers the essential elements in managing learning within a competitive environment. In terms of acquiring knowledge, there are majority of the students (80.6%) have shown somewhat agree to strongly agree that they view students as a valid representation of reality to acquire applicable knowledge. 76.2% students somewhat agree to strongly agree that the user interface of simulation games is easy to use. The findings have revealed that the level of students' perceptions regarding simulation game is significantly at a high level. They strongly agree that simulation game can act as learning tool and improve their learning.

Then, we also examine students' learning from participating in the simulation game. There are majority of the students (42.9% strongly agree, 19% agree and 21.4% somewhat agree) indicated that the strategic decisions taken by their group have to forecasted effects in the simulation game and simulation game also provides them with knowledge that they can apply in learning in real life. Moreover, most of the students believed that playing the simulation game demanded more in the course than a regular teaching method does (40.5% strongly agree, 21.4% agree, 16.7% somewhat agree).

If we view the responses of students in social learnings from participating in the simulation game, there are 45.2% students strongly agree that they felt that there were relevant to have a nominated CEO to organize and lead the group during simulation game. There are 17 students rather choose their own group members than the lecturer decides them in group with. Additionally, there are majority of the students (83.3%) students with high frequency, from somewhat agree to strongly agree that they experienced that some in their group did not participate in the group work as expected and cross-cultural differences positively affected teamwork. There are 50% of students strongly agree that the simulation game holds potential to be included in their learning course. This means that majority of the students agree that simulation game holds potential to be included in their learning course. This means that majority of the students agree that simulation game is a recommended tool for future use due to at least 59.5% students are agreed and strongly agreed for all items tested in recommendation simulation game for future use.

To what extend students benefited from participating simulation games, there are 54.8% agree and strongly agree that simulation games increase their interest for the industry, increase their understanding of the factors that contribute to

operating a successful business and give them the chance to speak out and be part of the decision-making process more than a normal lecture environment. For how satisfied students are with the simulation games, there are 64.3% students agree and strongly agree that playing the simulation game raised their interest for the leadership and strategy disciplines in general. To conclude the findings, most of the students give positive responses for satisfaction, benefits, recommendations, learnings and social learning from participating simulation games. Overall their perceptions regarding the simulation game also highly positive, including user-friendly interface.

In order to determine the relationship between students' reasons why using simulation games, perceptions of using simulation games as learning tools, and learning from participating simulation games, the Pearson's correlation analysis is conducted. Table 2 indicated the correlations among these three dimensions. It is obvious that all three dimensions were significantly and positively correlated (correlation coefficients = .974 - .985). Simultaneously, the stepwise regression analysis is used to examine the roles of students' perceptions of using simulation games as learning tools in influencing their learning from participating simulation game.

Table 2 The Correlations among Reasons of Using Simulation Games, Students' Perceptions of Using Simulation Games as Learning Tool, and Students' Learning from Participating Simulation Game

	Reasons of using simulation game	Perceptions of using simulation game as learning tool	Learning from participating simulation game
Reasons of using simulation game	-	-	-
Perceptions of using simulation game as learning tool	0.984**	-	-
Learning from participating simulation game	0.974**	0.985**	-

Note: ** $p < .01$ (2-tailed); N = 42

Table 3 has presented the stepwise regression results of students' perceptions of using simulation games as learning tool in predicting their learning. There are three perceptions, named 'I view the simulation as a valid representation of reality to acquire applicable knowledge', 'the simulation game environment provide the possibility to apply relevant theoretical knowledge to the game' and 'I perceive the user-interface as easy to use (user-friendly)' play the strong roles in predicting students learning with the variances ($R^2 = 0.977$). The t-test values also shown that the findings are significant at $p < 0.01$. This means that 'I view the simulation as a valid representation of reality to acquire applicable knowledge' ($\beta = 0.57$, $p < 0.01$) is the main perception that affects students learning from participating simulation games. The combination of these three

perceptions contribute to 97.7% of the variances in students' learning from participating simulation games from this finding.

Table 3 The Stepwise Regression Model of Students' Perceptions of Using Simulation Games as Learning Tool in Predicting Their Learning (N=42)

Students' learning from participating Simulation Games	B	Std. Error	β	T	R
P4. I view the simulation as a valid representation of reality to acquire applicable knowledge	0.61	0.08	0.57	7.20**	0.989
P3. The simulation game environment provides the possibility to apply relevant theoretical knowledge to the game	0.21	0.07	0.25	2.90**	
P5. I perceive the user-interface as easy to use (user-friendly)	0.19	0.08	0.19	2.41**	

Note: **p<0.01; Dependent variable: Students' learning from participating simulation game

4.0 DISCUSSIONS AND CONCLUSION

Lack of acceptance of simulation games as learning tools among the majority teachers and students is still a notably issue and more rigorous baseline studies need to be conducted to map the different uses of simulation games and quantify their effectiveness. The transformation of higher education which involving the pedagogical change, from lecturer-centred to student-centred, and increasing the utilization of simulation games as learning tool are expected to play a significant role in influencing students learning process. Furthermore, the majority of Malaysian university lecturers also had preferable attitudes toward utilizing digital games as a motivational, an instructional and a collaboration tool in their teaching and learning in higher education institutions from the previous findings. Hence, this shown the high potential of integrating simulation games in the teaching and learning process in higher education. This study needs further research which involving more participants from different schools and higher education institutions to obtain empirical statistical analysis regarding the influences of simulation games in STEM learning. The comparison studies need to be conducted for urban, sub-urban and rural schools for longer period and longitudinal study for the impacts of simulation games on STEM learning. The findings of this survey have presented that most of the respondents agree and give positive responds on utilization simulation games as learning tool in higher education institution as they expected simulation games can raise their interest in their learning environment. The findings also indicated that a significant positive perception from students regarding simulation game as learning tool. It also

supported by prior studies revealed that simulation games play an important role in instructional support, particularly learning objectives involve higher order skills, reflection, modelling, advice, collaboration, individualization, narrative, control and other relevant instructional elements [31]. Other scholars also reported simulation games can be tailored to meet the desired learning objectives, and outcomes [32, 33, 34]. Furthermore, students' perceptions (simulation as valid presentation, apply relevant theoretical knowledge to the game, and ease of use interface) also have shown their predictive effect in their learning from the participation of simulation game, with the variances 97.7%. Students also shown their strong confident that they satisfied the benefits and learning from participating in the simulation game. Clear guidance on course information, realistic complexity, rewards or awards for interaction between instructors and students or peer-to-peer interaction are the factors that can be considered to improve the effectiveness of simulation games integrated in instructional design. All in all, simulation games are recommended as learning tool in higher education from the overall students' perceptions in the survey.

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