

Designing an Online Simulation Board Game with Realistic Patients and Dynamic Electrocardiogram Situations for Learning First Aid Abilities

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Abstract

Due to the pandemic of COVID-19, many physical first aid courses have been converted to online courses. However, first aid courses emphasize providing realistic situations that facilitate the learner's ability to make accurate and immediate judgments and decisions according to patients' conditions. This study aims to develop an online educational board game, - *Heartbeat Moment* (beta) with a contextual and authentic learning environment using Google Jamboard application for learning first aid abilities. By providing simulated dynamic electrocardiogram data and descriptions of the patients' conditions to create an authentic environment and improve the ability to make correct decisions on the treatment methods according to the patient's condition. The learner also asked to decide the treatment sequence based on the electrocardiogram and clinical conditions of each patient card and adhere to the principle of priority treatment for emergency and severe cases. Through our preliminary analysis, it is found that. Although the progress in learning outcomes is limited (there was no significant difference between the scores of the pre-test and the post-test), the level of learner engagement is high. All learners were analyzed for their flow status and technology acceptance. The results showed that the overall flow and game acceptance were significantly higher than the median (the median in a five-point scale =3). A high level of flow means that the learner is fully engaged in the learning activity and demonstrates a high level of concentration, which is critical to first aid learning and may facilitate objective analysis and decision making for the patient's condition.

Keywords: Simulation-Based Learning, Online Educational Game, Board Game, Acute Care, Dynamic Electrocardiogram, Decision-Making

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Introduction

Due to the COVID-19 epidemic, many first aid courses were then converted to online courses. However, the first aid courses pay great attention to authenticity and practicality, so that students are familiar with the actual situation and respond immediately after practicing to improve the treatment rate of patients. Many studies showed that first aid courses for nursing staffs in simulated situations with setting up real scenes and repeated simulation exercises to improve the quality of nursing patients is very important (Abelsson, Rystedt, Suserud & Lindwall, 2016 ; Kosoko, Glomb, Laba, Galapi, Shah, Rus, & Doughty, 2019).

Simulation games allow learners to learn problem-solving skills in the game, and apply actual situations through repeated operations and reflection on whether the decision is correct or not. Simulation games based on situated learning theory improve learners' learning transfer in real contexts (Hou, 2015; Hou & Li, 2014; Brown, Collins, & Duguid, 1989) and may increase students' learning motivation, academic performance and problem-solving ability (Huang, He, & Wang, 2020 ; Sung, Hwang, & Yen, 2014 ; Faizan, Loffler, Heininger, Utesch, & Kremer, 2019).

Misinterpretation of the electrocardiogram (ECG) may lead to inappropriate clinical decision-making, leading to undesirable consequences (Viljoen, Millar, Manning & Burch, 2020; Bogun et al., 2004) and even patient death. Simply teaching ECG courses without case sharing may hinder students from coordinating clinical situations and heart rate presentations, thereby affecting the speed of ECG interpretation and the quality of treatment for patients (Jablonover, Lundberg, Zhang, & Stagnaro, 2014; Graham, Jivendra, & Makani, 2015).

There are few simulation educational online gamification activities for ECG teaching courses recently. Therefore, our research team (Mini Educational Game development group in e-Learning Research Center, National Taiwan University of Science and Technology, NTUSTMEG) applied Google Jamboard to develop an online simulation board game, *Heartbeat Moment* (beta version).

Each learner has 3 pages of Google Jamboard. The emergency area on the first page contains 3 cards of the patient to be treated. After scanning the QR code on each patient card, the electrocardiogram of dynamically display will be shown, as well as the description of the patient's condition (including vital signs and chief complaints) (Figure 1). The second page has the treatment drugs and equipment may be needed by the patients (Figure 2), and the third page has the observation area or the death area for the patient cards according to the treatment results (Figure 3). At the same time, there will be 3 patient cards randomly entering the first page for emergency treatment. A total of 12 patients need to go through 4 levels. The bell will ring every 3 minutes. The learner must decide the treatment sequence based on the electrocardiogram and clinical conditions of each patient card, and adhere to the principle of priority treatment for emergency and severe cases. Each player has three opportunities to call an expert, who will provide clues and tips to help the player pass the level according to the current situation. If learners do not deal with the severe illness first, patient will be declared dead. The purpose of game-based learning activity is to facilitate students to assess the clinical condition of the patient based on their own prior knowledge and cultivate the correct decision-making ability.

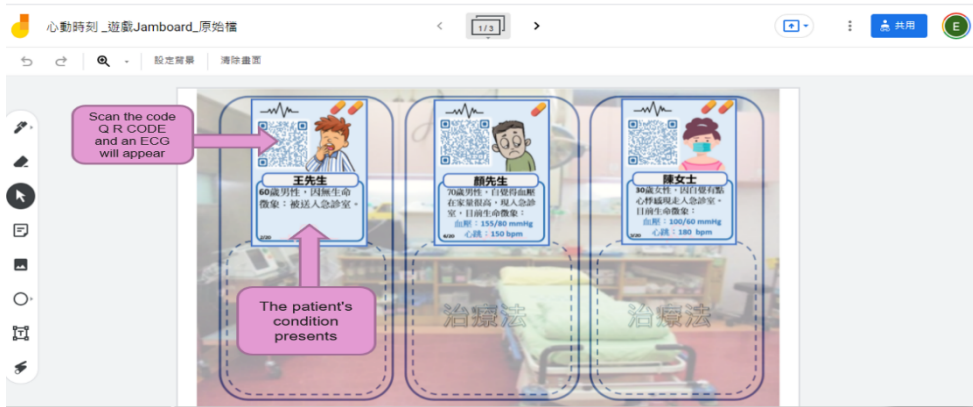


Figure 1 The emergency area on the first page



Figure 2 The second page has the treatment drugs and equipments

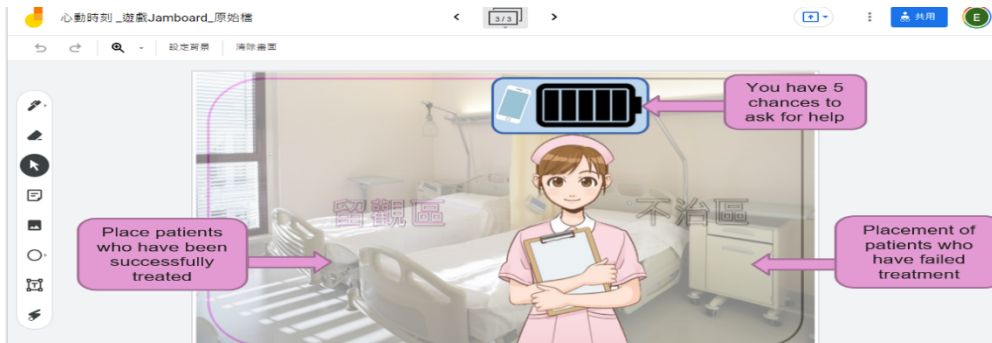


Figure 3 The third page has the observation area or the death area

Research Purposes and Questions

This study aims to explore students' learning performance, flow and game acceptance during the game. The research purposes of this study are as follows:

1. To explore learners' learning performance of online simulation board game
2. To explore learners' flow of online simulation board game
3. To explore learners' game acceptance of online simulation board game

Method

Participants in this study were 12 adults (1 male, 11 female) in Taiwan, and they were all emergency room nurses. Each participant uses a personal computer to participate in learning

activities. In the analysis of learning performance, the contents of pretest and the posttest were the same. The test was designed referring to the case of investigating the Advanced Cardiac Life Support, 10 items in total. The questionnaire contains flow and game acceptance scales. To evaluate the learners' flow, this study applied Kiili (2006) flow scale which was translated and revised by Hou and Li (2014). The flow scale includes two dimensions, namely the flow antecedent and flow experience. All scales were scored on a five-point Likert scale, a total of 22 items, and reached a very high degree of consistency (Cronbach's $\alpha = 0.91$). Regarding the acceptance, the study adapted and revised Davis's (1989) The Technology Acceptance Model items. There are 8 items including usefulness, ease of use, and game elements. Cronbach's $\alpha=0.89$ reached high degree of consistency. Learning activity procedures were as follow: first learners had the pretest (10 minutes), and played the game (30 minutes). Then, after the gameplay, there were the posttest (10 minutes) and the flow and game acceptance questionnaires (10 minutes).

Results and Discussions

For learning performance, a Wilcoxon signed rank test was used to compare the results showed there was a no significant difference in the score for the pre-test and post-test ($Z=-1.127$, $p=.26$). The result found that the learner's performance was not enhanced significantly. The possible reason is that the learners may only tried to imitated the behaviors or process of their predecessors in working places, but did not know the principle of treatment. Therefore, learners cannot answer the correct answer in the tests because they do not understand the real reason for treatment. As for the flow, the overall flow score ($M=4.34$), sub-dimension flow antecedent ($M=4.29$), and sub-dimension flow experience ($M=4.38$) showed the high flow scores. The result of flow was analyzed by one sample t test, and the result showed that all dimensions were significantly ($p<0.05$) higher than the median (median of the five-point system = 3). Learners were very engaged in the game.

The result of game acceptance was analyzed by one sample t-tests., and the result revealed that usefulness ($M=4.80$), ease of use ($M=4.53$), and game elements ($M=4.61$), were also significantly ($p<0.001$) higher than the median (the median in a five-point scale =3). Learners had a high degree of acceptance of the game, and considered it is helpful and easy to operate for learning.

Table 1 The Mean and Standard Deviation of Learning Performance.

	M	SD	Z	Sig.
pre-test	56.67	23.87	-1.127	.26
post-test	60.00	25.23		

* $p < .05$

Table2 The Mean and Standard Deviation of Flow State Scores.

Dimensions	M	SD	t
Flow antecedents	4.29	0.66	6.74***
Challenge	4.21	1.01	4.14*
Goal	4.67	0.54	10.76***
Feedback	4.29	0.78	5.72***
Control	4.42	0.85	5.79***
Playability	3.88	1.05	2.90*
Flow experience	4.38	0.42	11.53***
Concentration	4.60	0.47	11.82***

Time distortion	3.83	1.07	2.69*
Autotelic experience	4.73	0.39	15.32***
Loss of self-consciousness	3.80	1.23	2.22*
Overall Flow	4.34	0.46	10.13***

* $p < .05$, *** $p < .001$

Table3 The Mean and Standard Deviation of Technology Acceptance Model, TAM State Scores.

Dimensions	M	SD	t
usefulness	4.80	0.40	15.65***
ease of use	4.53	0.52	10.15***
Game elements	4.61	0.53	10.56***

*** $p < .001$

Conclusion

This study developed an online simulation board game, *Heartbeat Moment* (beta version) and learners were all involved and engaged in the game and considered that this game could assist their learning and easy to use. However, the learning performance was not significantly improved. It might be that learners only imitated behavior without in-depth understanding the real reason for treatment.

This online educational board game is closer to the actual clinical situation, and the simulation of authenticity may be helpful to the learning practice. The online simulation board game promotes learners' flow and repeat the exercises. For the future study, design cognitive mechanism to help learners understand the reason behind the treatment should be considered. Empirical study with control group needs to be conducted to deeply investigate the effectiveness of online educational board game.

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