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The Development and Evaluation of an Educational Board Game Integrated with Augmented Reality, Role-Playing, and Situated Cases for Anti-Drug Education

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Abstract: The study developed a game on mobile device, Saving the City of Drug©, integrating the image recognition technique of augmented reality and board game to promote learners acquiring the knowledge of anti-drug, and investigated learners' learning performance, technology acceptance and flow state in the game through preliminary empirical research. The results showed that learners' learning effectiveness of the knowledge of zero drug abuse had significant improvement after the game. Moreover, learners had high state of flow in the activity and high technology acceptance as well.

Keywords: Augmented reality, role-playing, situated case, drug education

1. Introduction

Abuse of drug cause serious problems around the world by years. There has led to a growing concern about promoting anti-drug education among educator in the world (Fok & Tsang, 2005). However, the students may not be able to understand this issue very well with low learning motivation in traditional education (Hawthorne, 2001). Compared with the traditional teaching approach, information technology combined with game-based learning is considered to be an ideal way to improve students' learning performance and motivation (Brom, Preuss, & Klement, 2011). A number of studies indicated that the digital games have been considered as a helpful approach in anti-drug education (Schweizer, Hayslett, Bansal, Ronco, & Schafer, 2014; Yang, Chen, & Sun, 2017). Digital games not only provide realistic scenarios but also provide learners with role-playing and team-work mechanisms, and integrate with role-playing and situated learning strategies (Hou, 2012). Cheng & Tsai (2013) indicated that augmented reality could bring a brand-new way of science learning and facilitate the enhancement of students' learning effectiveness. McLaren, Adams, Mayer, & Forlizzi (2017) suggested that board game is certainly an effective teaching tool. Several studies revealed that augmented reality (AR) combined with board game could promote students' learning achievement (Li, Wang, Chen, Kuo, Hou, 2017; Wang, Chen, Hou, & Li; 2017). Therefore, our research team (Mini Educational Game development group in e-Learning Research Center, National Taiwan University of Science and Technology) developed an educational game App, Saving the City of Drug©, which was integrated the image recognition technique of AR and board game. This game has role-playing and team-work mechanism. Each player get different character card, such as teachers, police officers and students and situated case card. Players have to analyze the situation of drug users of the situated case card, afterwards, decide what their characters can do to help out drug users through group discussion. By the AR of the game's APP, players can scan various cards to obtain more clues and hints. The clues and hints can be scaffolding to lead peer to complete deep discussion and obtain more reflection of the case.

The aims of the study are not only to develop an educational game in anti-drug learning but also to evaluate the learners' learning performance, flow, and technology acceptance in the game.

Figure 1. Game kits of Saving the City of Drug

Figure 2. Students discuss, tag the board game cards with mobile device.

2. Method

Participants in this study were 24 junior high school students in northern Taiwan (23 males, 21 females, their average age was 14.07). Students were grouped with four members in each group. Each group was given a tablet computer and a board game for this learning activity

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 anti-drug education, including 10 questions. In order to explore the learners' technology acceptance and flow, this study referred to Davis's (1989) technology acceptance model to evaluate the learner's attitudes toward perceived usefulness and perceived ease of use. Participants' flow state was evaluated using Kiili's flow scale (2006), which was translated and revised by Hou and Chou (2012). The flow scale includes two dimensions, namely the flow antecedent and flow experience. All scales were scored on a five-point Likert scale. The reliability of the technology acceptance questionnaire (Cronbach's alpha=0.84) and the flow questionnaire (Cronbach's alpha=0.91) showed high internal consistency. The procedure of the learning activity firstly had the pretest (10 minutes), and played the game (30 minutes), which was followed by the posttest (10 minutes) and the technology acceptance questionnaire and the flow questionnaire (10 minutes).

3. Results and Discussion

For learning performance, a paired-samples t-test was used to compare the results of learning performance between the pretest and posttest. The results showed there was a significant difference in the score for the pre-test and post-test ($t=-6.995$, $p<0.001$), and it suggested that learners' knowledge of anti-drug improved through this game. The means of technology acceptance were as shown in Table 1, the overall scores (M=4.38) and the scores for each dimension were above four, which suggested that the learners' perceived usefulness (M=4.54) and perceived ease of use (M=4.17) were high. As for the flow, the overall flow score (M=4.05), flow antecedent (M=4.10), and flow experience (M=4.02) were all above the median (the median in a five-point scale =3) (see Table 2). The results indicated that learners were deeply involved in the game and perceived the game to be useful for learning.

Table 1 *The mean and standard deviation of technology acceptance scores*

Dimensions	M	SD
TAM	4.38	0.58
Usefulness	4.54	0.58
Ease of use	4.17	0.79

Table2 *The mean and standard deviation of flow state scores*

Dimensions	M	SD
Flow	4.05	0.56
Flow antecedent	4.10	0.54
Flow experience	4.02	0.65

4. Conclusion

These preliminary findings showed the effectiveness of employing AR and educational board game in promoting learners' motive and learning achievement. Future study would employ the quasi-experiment design to compare the effectiveness and usefulness of this game with control group (i.e., lecture classroom). On the other hand, It is suggested that researchers are encouraged to explore learners' behavioral patterns when playing the game in the future (e.g., Hou, 2012), and it will help us better understand the influence of the game which integrates AR and educational board game in learning activity.

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