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Designing a Digital Adventure Game Integrating Instant Feedbacks with Simulation Manipulation to Promote Learners' Knowledge of Computer Hardware

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Abstract: This study designed and developed an adventure game of room escape -*Boom Room*© integrating feedback of instant guidance and simulation manipulation. Through an empirical evaluation, this paper preliminarily explores learners' perceived usefulness and perceived ease of use toward this game. Also, this paper explores learners' attitudes toward each game element in this game. This paper provides relevant limitations and suggestions for future researches.
Keywords: Game-based learning, Simulation manipulation, Adventure game

1. Introduction

Digital games which are challenging and entertaining [1] help learners have learning motivations [2]. The application of digital games to the instructional strategies and the subject domains is getting more and more diverse. The suitable guidance and prompts provided in the instructional games can help students to learn during playing process (e.g. [3]). Among numerous types of games, adventure games can provide learners the learning situations and highly challengeable tasks. Combining the manipulation features of instructional simulation software [4] in adventure games and providing guiding feedback to allow learners to reach the learning objectives by repeatedly manipulating composing objects, it will be expected to produce more effectively meaningful learning and it will be suitable to the instruction of procedural knowledge. The present relevant studies and development of the instructional games combining simulation manipulation and guiding feedback are still limited. Therefore, the main purpose of this study is to design and develop an adventure game of room escape-*Boom Room*© (shown in Figure 1 & 2) integrating feedback on instant cues and the situations of simulation manipulation to instruct the concepts of computer hardware and procedural knowledge of PC DIY. The situations and mechanism in this game are: the learners are trapped in a room which is locked on the other side and there's a time bomb in it. The players have to pause the bomb timer in 10 minutes. The decoding codes are stored in a portable USB disc, but no computer can read the information in it. The players need to repeatedly look for the computer components (e.g., mainboard and graphic card etc.) hidden in the room and then assemble correctly to pause the bomb timer. If the players have wrong sequence of action and components search, the system will provide instant guidance cues which help students to reflect and retrospect their prior knowledge and assembling strategies and help them learn the computer hardware knowledge. This game provided with the challenging elements (i.e., time limitation and objects search), guidance cues (instant feedback), and simulation manipulation (assembling a computer) can be expected to help learners learn computer knowledge during the game.

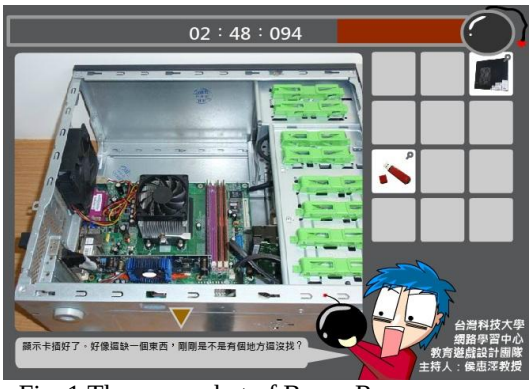

Fig. 1 The screenshot of Boom Room: Simulation manipulation and Feedbacks

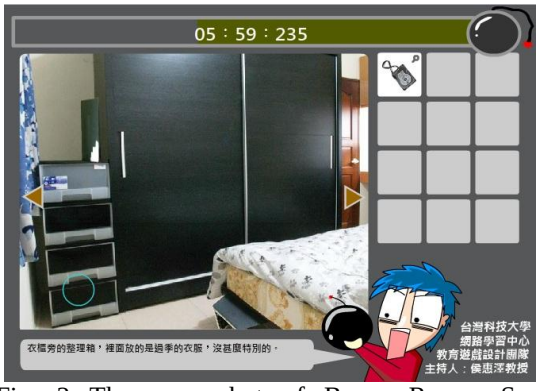

Fig. 2 The screenshot of Boom Room: Search for the environment and cues

The other purpose of this study is going to explore learners' perceived usefulness and perceived ease of use toward this game. Also, this paper explored learners' attitudes toward game elements in this game.

2. Method

20 college students participated in this study, including 7 males and 13 females. The average age of the participants was 23 years old. All students majored in the same core course related to basic computer literacy. To evaluate the adventure games, this paper referred to the literature, that is, the technology acceptance model [5] and the elements of digital instructional games ([1][4]) to make a preliminary evaluation of learners' attitudes toward perceived usefulness of this game (e.g., if they can reach the learning objectives), perceived ease of use (e.g., if it is easy to operate), and each game element (e.g., challenge and entertainment etc.) in this game. The questionnaire was shown in Table 1. Each dimension, its references, and items were provided. Each item was scored on a 4-point Likert scale (1= strongly disagree, 2=disagree, 3=agree and 4=strongly agree). The students were asked to play *Boom Room*© (10 minutes) once, and then fill out the questionnaire. We analyzed and discussed the questionnaires finished by the students.

Table 1 Evaluation questionnaire on the technology acceptance and game elements

Dimension	Item#	Item	References
Perceived usefulness	Q1	This game can help you understand the structure of the computer hardware more.	Davis (1989)
	Q2	This game can help you understand the procedures of assembling computers.	
	Q3	Compared with the paper textbooks, you think this game helps you understand the structure of the computers more.	
Perceived ease of use	Q4	The operation of this game is easy.	
	Q5	The logic of the game plots is easy to understand.	
	Q6	The operating process of this game is smooth without any errors.	
Game elements	Q7	This game is entertaining.	Prensky & Thiagarajan (2007) Alessi & Trollip(2001)
	Q8	This game is challenging.	
	Q9	When you play the game, you feel the uncertainty of adventure and fantasy.	
	Q10	The design of the mechanism of the interactive rules in this game is appropriate.	

3. Results and discussions

This study was a preliminary evaluation, so we simply conducted a preliminary descriptive statistical analysis based on the data. Regarding the perceived usefulness, we discover that 85% (n=17) of the students agree or strongly agree that this game can help them understand the structure of the computer hardware more; 90% (n=18) of the students agree or strongly agree that this game can help them to understand the procedures of assembling computers; also, 90% (n=18) of the students agree or strongly agree that this game helps them

understand the structure of the computers comparing to the paper textbooks. The findings demonstrate that learners give a high evaluation on the perceived usefulness of this game, indicating that the combination of instant feedback and adventure games with the feature of manipulation help them learn the concept and procedural knowledge of computer hardware to a certain degree. Regarding the perceived ease of use, 70% (n=14) of the students agree or strongly agree that the operation of this game is easy; 85% (n=17) of the students agree or strongly agree that the logic of the game plots is easy to understand; also, 75% (n=15) of the students agree or strongly agree that the operating process of this game is smooth without any errors. Based on the results, we know that roughly over 70% of the students have positive attitudes toward the perceived usefulness. However, there is still room for improvement, particularly the operation and the smoothness of this game. Regarding the evaluation of each game element, 85% (n=17) of the students agree or strongly agree that this game is amusing; 90% (n=18) of the students agree or strongly agree that this game is challenging; 70% (n=14) of the students agree or strongly agree that they can feel a sense of adventure and fantasy during the game; also, 75% (n=15) of the students agree or strongly agree that the mechanism of the interactive rules in this game is designed well. The results here indicate that this game has higher challenge and entertainment; students have 70% positive attitudes toward the design of fantasy and interaction mechanism, but the limitations are still existed. The reasons are: although the adventure of bomb threats is provided in this game, a higher realistic display makes the fantasy of the game limited. On the other hand, users need to move to and fro between the *tool box* and *main scene window* during the process of simulation manipulation and objects search, which may make the smoothness of the perceived ease of use restricted.

4. Conclusion and suggestions

Our research team designed and developed an adventure game integrating feedback of instant guidance with strategies for simulation manipulation and conducted a preliminarily empirical evaluation. The findings in this study indicate that this game has potential to promote the learning of computer hardware knowledge to a certain degree. Regarding the perceived ease of use in this game, there is still room for improvement. We suggest this game should have a more friendly design of the operating mechanism; besides, to understand the features and limitations of this game more deeply, the analysis of behavior logs and the exploration of flow experience are also suggested in the future.

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