Development and Evaluation of the Operational Management Simulation Game E-Café

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Abstract

In an educational environment, instructors typically think of ways to provide students with motivational learning materials and efficient learning strategies. Numerous researchers have proposed that students' problem-solving ability enhances their learning. Problem-solving ability plays a crucial role in students addressing problems that arise during their learning. To facilitate high-quality performance, managers have been trained to solve the problems they encounter. The purpose of this study was to develop an educational game for the management of a coffee shop. To ensure the quality of the simulation game, our research involved using design-based research to develop the simulation game and conducted usability testing to evaluate its effectiveness. The usability test results demonstrated that the quality, use, and learning effectiveness of the educational game, received highly positive feedback and acceptance from users.

Key Words: Design-based Research, Game-based Learning, Business Management Problem, Usability Test

1. Introduction

With the development of information technology, increasing numbers of college students have started to use various electronic devices such as PCs, laptops, smart phones, and tablets. Numerous students enjoy playing games on their electronic devices, and digital simulation games have been designed to be more visual, interactive, and focused on problem-solving [1]. Game-based learning (GBL) is a frequently used instructional method that has demonstrated potential in e-learning, and numerous studies have addressed various related research topics. Similar to entertainment and serious gaming, GBL has introduced a new crucial marketing direction for practical technologies such as human- computer interaction, mul-

timedia interaction, and ubiquitous computing [2]. Consequently, the educational potential of using computer and video games has been recognized. Several commercially successful games, although not designed for such purposes, integrate learning, socializing, and interacting strategies. In GBL, allowing students to learn with game awareness rather than learning awareness is crucial. Similar to commercial and online games, educational games facilitate the immersion of people into a specific game setting. Designing educational games that motivate students to think beyond the setting of the game is likely to enable students to learn with increased game awareness rather than learning awareness [3]. GBL is attractive to students who seek to acquire complex knowledge through digital simulation games.

Therefore, this study developed an educational game that simulates the business management of an e-café. The

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game was intended as learning material and the research involved using design-based research (DBR) to evaluate the design and development of this game. This study integrated the principle of "usability" to determine whether this material corresponds to the aforementioned principle and whether the developed game could meet the expectations of learners as an education resource [4].

2. Related Work

2.1 Digital Simulation Games

Digital simulation games are used for education and training in a wide range of fields, including the military, medical services, and scientific experiments. In contrast to digital games, simulation games are usually less associated with fantasy. Simulation games involve players assuming roles through which they seek to resolve problems or accomplish missions [5]. Digital simulation facilitates learning within created scenarios while allowing users to enjoy games that greatly resemble real-life situations. Following a series of game activities, learners respond to various scenarios while achieving learning objectives. Researchers have indicated that digital games with educational functions can exert a positive effect on learners regarding motivation and performance [6,7]. Numerous simulation games employ teaching strategies enabling users to develop independent thinking, self-reflection, problem solving, and creativity. To develop effective learning strategies, it is crucial for users to identify, construct, and analyze certain problems, and then conceive of possible methods to solve them. From the perspective of a learner, problem-based learnig (PBL) emphasizes active learning, the identification of problems, thinking ability, and the process of solving problems. Furthermore, using PBL wirh simulation game enabled students to improve their critical thinking [8].

2.2 Usability Testing

Testing usability reveals whether a given product serves the needs of users and whether the product can be operated intuitively. Several studies have proposed five indicators for the evaluation of usability: learning ability, efficiency, memorability, error, and satisfaction. These indicators can be used to determine whether users are able to browse a webpage without facing obstacles, whe-

ther the page can be accessed intuitively, and whether the webpage provides sufficient information to satisfy the needs of users. The International Organization for Standardization (ISO) indicated in 1998 (ISO 9241-11) that "Usability' refers to the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use." The most common methods employed in the evaluation of usability include heuristic evaluation and usability testing. This study recruited participants with the aim of identifying user problems, evaluating the usability of the educational simulation game, and providing a basis on which to revise teaching materials in the future.

2.3 Design-based Research

Design-based research (DBR) is a research methodology and also known as design experiments. It is defined as "an emerging paradigm for the study of learning in content through the systematic design and study of instructional strategies and tools" [9]. The purpose of DBR is to avoid invoking mistaken identification with experimental design, with study designers, or with a trail of teaching methods [9]. Thus, the DBR approach is an iterative cycle comprising multiple steps, including design exploration, interventions enactment, outcome evaluation and analysis, and redesign [9–12].

3. System Design and Architecture

System design is a critical factor for learners and instructors [13] and includes database design and synchronization mechanisms [14]. In this section, the architecture and flow chart of the designed system are provided.

3.1 System Design and Architecture

Figure 1 depicts the proposed GBL environment. This research divided the environment into three parts: instructor monitoring, game delivery, and service processing server/database. The detailed discussion is presented below:

3.1.1 Instructor Monitoring

In this research, we extended our existing research experience on GBL to help instructors monitor student performance during game playing. Although this research
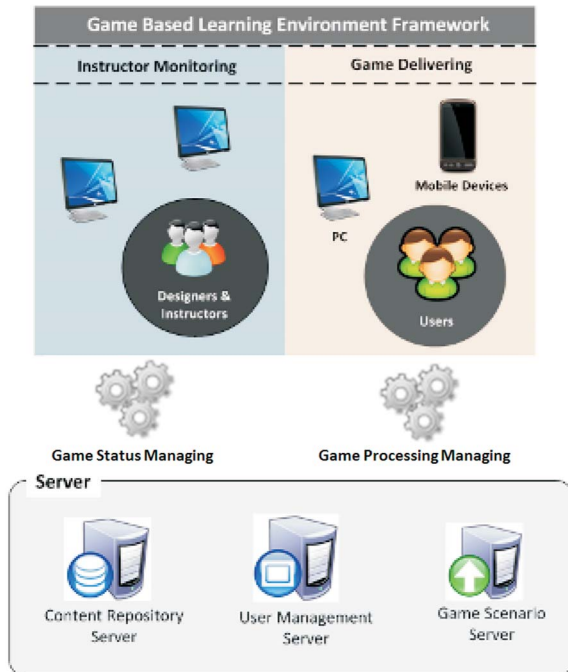
Figure 1. System architecture for e-café game.

focused on self-learning, assistance and feedback from the instructors enabled identifying weaknesses that the students might not have identified themselves.

3.1.2 Game Delivery

After the instructors and designers designed the contents, users accessed the URL to play the game on a PC or portable device. The playing records for each user were stored in a database.

3.1.3 Service Processing Server and Database

In this research, we designed three main data-storage databases and data processing servers: a content repository, user-management, and game-playing server.

These three servers/databases were used to process and store data as well as send and receive all game-related information.

3.2 Operation Flowchart of the Proposed System

Figure 2 shows the operating flowchart of the proposed e-café. First, users were required to log in or register with the system if they did not own an account. New users were required to perform two setups: providing their background information and choosing an e-café-shop default setup. The background information comprised gen-

der, educational major, and age. The e-café-shop default setup comprised the following information: location of the e-café shop, store decoration style, basic expenses, raw material purchasing, and product sales prices. The third step involved playing the game, which constituted the main part of this research. During the game, the system would assign random missions at random intervals. If the assigned mission was completed, the average daily customer flow would increase. If the mission was not accomplished, the average daily customer flow would decrease. The missions were directly related to the flow of customers, because the average daily customer flow was one of the most crucial determinants of income.

In addition, the missions required knowledge of topics including cost budget control and human resources. These missions served as factors influencing shop operating management, and profit was the main evaluative factor determining whether users passed the first level. If a user passed the first level, the game would proceed to the next level. If a user failed to cross the required threshold, the game would remain at the same level. After playing the game, the instructors reviewed the students' game re-
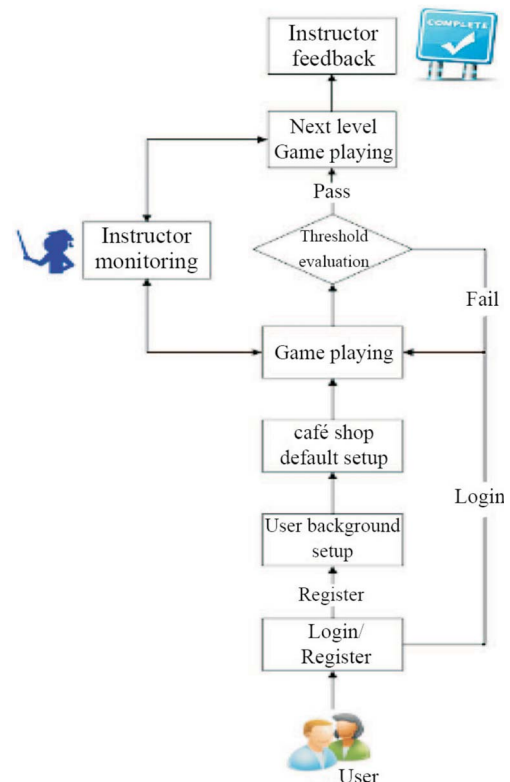

Figure 2. Shows the operating flowchart of the proposed e-café game.

cords and their questionnaires. Figures 3 and 4 show the game records and detailed mission statuses of the users.

3.3 Game Design

3.3.1 Applying Design-Based Research to the E-Café Simulation Game

Design-based research combines learning theory, di-

ID	Name	Game Record	Times	Questionnaire
A016	巧立	Record	2	Questionnaire
A018	QQ	Record	2	Questionnaire
A019	U	Record	2	Questionnaire
A020	mike	Record	2	Questionnaire
A021	QQ	Record	2	Questionnaire
A022	呱呱	Record	1	Questionnaire
A023	A023	Record	1	Questionnaire
A024	星巴客	Record	9	Questionnaire
A025	王永慶	Record	1	Questionnaire
A026	七	Record	7	Questionnaire
A030	AA	Record	9	Questionnaire
A027	蘿蔔頭	Record	13	Questionnaire
A028	米霏斯爾	Record	2	Questionnaire
29	WHITE	Record	11	Questionnaire
A031	cc	Record	4	Questionnaire

Figure 3. Game playing records of students.

gital content design, and practical teaching and learning to achieve the goal of integrating innovative technology and learning theory into teaching [15]. Moreover, DBR is a systematic procedure that integrates design and research. We used the DBR method to conduct our research, including material design and development. All the research development underwent the instructional design system (ISD) procedures of the analysis, design, development, implementation, evaluation, and release (ADDIE) model (Figure 5). Furthermore, we adopted usability testing to confirm whether the game-based material was consistent with our research goal. The ADDIE process is a cyclic task that we used in our research [4]. Using circularly formative evaluations, the game-based material design was successively improved.

3.3.2 Game Content Design

The developed simulation game was easily to embed and provided a problem-based learning environment, which, combined with a situated learning strategy, allowed learners to enjoy their learning activities. E-café game

Number	Date	Starting Time	Finishing Time	Level	Sani-tation	Human Affairs	Train-ing	Market-ing	Produc-tion	Style	Change Role	Minimal	Maxmal
							Solved Missions					Profit	
1	2013-07-02	0	0	Level 1						Garden	0	120755	120755
2	2013-07-02	18:43	18:44	Level 1	0	0	0	0	0		0	120755	120845
3	2013-07-02	18:43	18:50	Level 1	1	0	1	0	1	Garden	0	120755	123527
4	2013-07-02	18:43	18:53	Level 1	2	0	1	1	2		0	120755	123527
5	2013-07-02	18:43	19:04	Level 1	4	0	3	2	7	Garden	0	29172	123527
6	2013-07-02	19:10	19:18	Level 1	5	0	4	3	9		0	-142675	29217
7	2013-07-02	19:10	19:37	Level 1	12	0	8	3	13	Garden	0	-142877	29217
8	2013-07-02	19:10	19:44	Level 1	15	0	11	3	16		0	-142877	29217
9	2013-07-02	19:10	19:46	Level 1	16	0	11	4	16	Garden	0	-142877	29217
10	2013-07-02	19:10	19:55	Level 1	17	0	12	4	17		0	-298867	29217
11	2013-07-02	19:10	19:57	Level 1	18	0	14	4	17	Garden	0	-298867	29217
12	2013-07-02	19:10	20:09	Level 1	22	0	15	5	23		0	-298867	29217
13	2013-07-04	18:08	18:19	Level 1	32	0	21	5	32	Garden	0	-299819	-292384
14	2013-07-04	18:08	18:39	Level 1	47	0	38	5	34		0	-471273	-292384

Figure 4. The detailed mission/game status of the users.
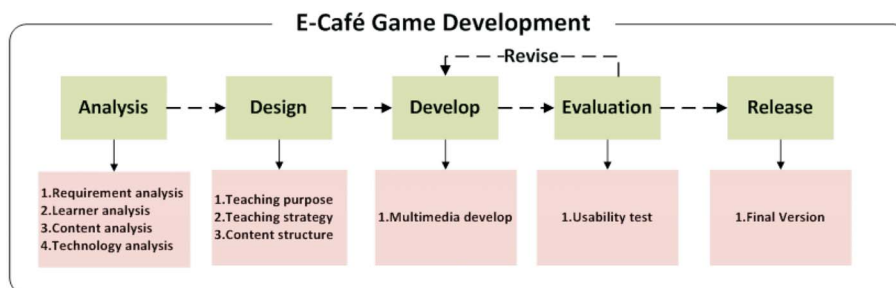

Figure 5. Instructional design of the e-café game.

desing must be linked to an overall theory of action and a substantive theorietical foundation for key themes around the topic of business management, including five major coceopts: sanitation, human resources, employee training, marketing and production. Figure 6 shows the basic elements of the developed e-café game. In this game, users must complete certain missions, which are conveyed to the player through instructions and hints. Table 1 shows the major specifications of the e-café simulation game.
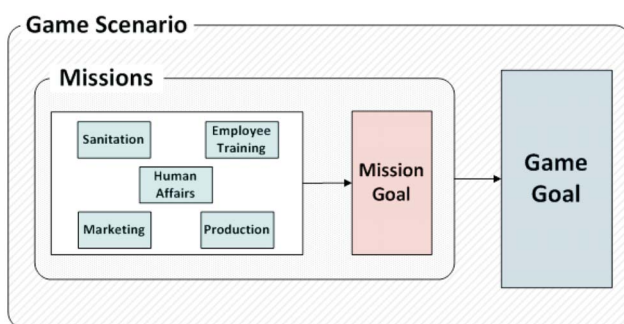

Figure 6. Basic elements of e-café game.

3.3.3 Game Playing Design

3.3.3.1 Identifying Missions and Problems

Figure 7(a) shows the bottomon right side of the e-café game main interface indicates the current number of missions and problems the user needs to counter. The details of the missions and problems appear promptly when the user clicks on the left side of coffee cup graphic interface (Figure 7(b)).

3.3.3.2 Analyzing the Missions and Problems

This interface shows the detailed information of missions and problems and recommends problem-solving strategies. The information is provided for a user to consider how to solve related problems (Figure 8).

3.3.3.3 Solving the Missions and Problems

After analyzing the missions and problems, the user must adjust the related sales prices under the raw material information interface (Figure 9) or make a staff on duty arrangement (Figure 10).

Table 1. Major specifications of the game design

Features	Students can learn how to manage the coffee shop via the e-café simulation game. There are five major domain concepts in the game including sanitation, human resources, employee training, marketing and production.
Gameplay rules	During the game playing, missions are randomly occurring for students. And, the missions could serve as the influential factors of shop management. With the different results of missions, it will affect the customer's satisfaction.
Game levels	With the game design, three game levels are developed in e-café simulation game. If the student's profit passes the threshold, the game will go to the next level. Also, if the student's profit is lower than the basic threshold, the game will be over.

(a)   (b)

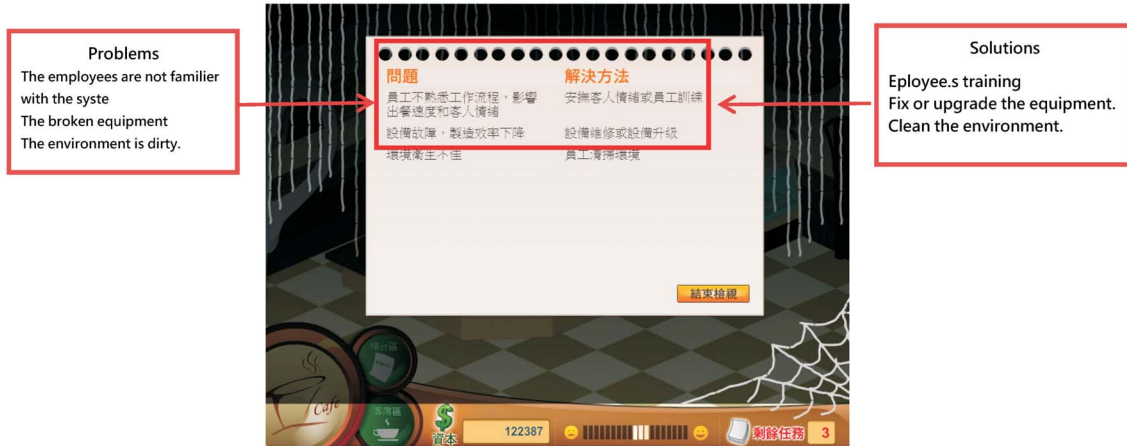**Figure 7.** Screenshot for e-café gamemain page interface.

Figure 8. Sreenshot for mission guide interface.

Figure 9. Screenshot for the adjustment on product prices.

Figure 10. Sreenshot for employees shift table interface.

3.3.3.4 Completing the Missions and Solving the Problems

When the missions are accomplished and the problems are solved by the user, the interface displays a completion screen (Figure 11).

4. Data Collection and Experiment

4.1 E-Café Game Evaluated by Design-based Research Approach

The design and development of the e-café game in this study were based on the DBR approach [16]. Figure 12 shows the concept of continual refinement is pivotal in DBR and isrelated to the usability test process [10]. Based on the research of Hartson, Andre, and Williges [18] and Rubin, Chisnell, and Spool [19], the usability evaluations performed in this study were tied to each phase of the DBR.

After the first version was developed and reviewed,

a usability evaluation was performed. The purpose of the formative usability evaluation was to obtain instant feedback from the iteration, design, and interaction from the earlier conceptual design and development [20].

We spent nearly one year to deveop the e-café game, and there are two versions (α version and β version) of e-café game in this study. The trial version (α version) was evaluated by 5 experts in educational technology field and 10 students. Based on the formative evlaution

Figure 11. Screenshot for the mission completed interface.

from trial version, we have done some revision of e-café game. Table 2 shows the revisions that were undertaken for the β version, based on the feedback that we received from the students and experts.

4.2 Mission Design and Analysis from Students' Game Playing Records

The e-café simulation game comprised five mission content domain categories: "sanitation", "human resources", "employee training", "marketing", and "production" (Table 3). After conducting data analysis and interviews with 53 students, three main reasons for this were identified.

First, the students lacked specific knowledge in the categories of "human resources" and "marketing". Several comments showed that they did not know how to solve this type of missions, and therefore they simply skipped certain missions. Second, the mechanism controlling the frequency of mission assignments was not appropriately designed. Several students indicated that most of the missions involved the domain categories of "sanitation", "employee training", and "production", and only a few of them concerned about the domaincategories of "human affairs" and "marketing". Finally, the difficulty of the missions was evaluated by the users, and several students indicated that the missions concerning about the categoires of "human resources" and "marketing" were too difficult to solve. They did not want to spend time on those missions. Based on the feedback from the students, our research involved improving these shortcomings and designing more missions. Besides, as shown in Figure 13, missions in the domain categories of "human affairs" and
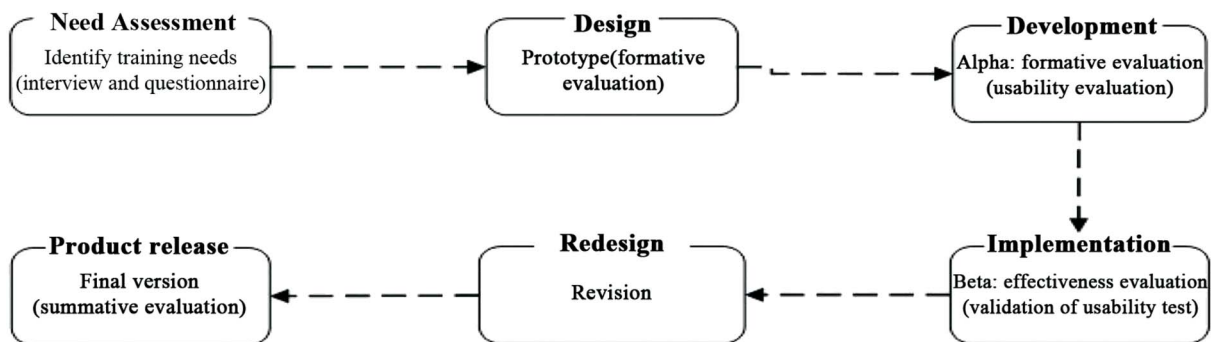

Figure 12. E-learning training material development process adopted from DBR [16] and [17].

Table 2. The revision content between α version and β version

Themes	Problems on α version	Revision (β version)
Content	1. The basic information related to financialis not very clear. 2. The information of skills training is not enough.	1. Note the default capital 2. Describe more features when user setting the default value in the beginning. 3. The salary of employee can be changed. 4. Add more detail information about Familiarization training
System interface	1. Several Typo errors found in the game 2. Sometimes, the information of stock lack was ignored by users.	1. Revise typo errors in the game. 2. Highlight the lack items with red color to attract users' attention.
Interaction	1. Several game buttons can't be pressed in several specific situations. 2. The default raw material prices are too high. 3. Users can't get the information of current customer in the café shop. 4. Some missions are repeated so often. 5. Some users have no idea about the prices of products.	1. Fixed the button pressed issues. 2. Adjust several default raw material prices. 3. Show the current amount of customers in the café shop on interface 4. Improve the repeatability of specific missions. 5. Show the suggested prices when users set the prices of products.

Table 3. The mission contents in the e-café simulation game

Category	Contents
Sanitation	1. Environment cleaning
Human resources	1. Insufficient number of employees 2. Employees working overtime
Employee training	1. Service attitude 2. Skills training
Marketing	1. Gaining good publicity 2. Arranging promotion strategies
Production	1. Equipment breakdown 2. Adjustment of raw material prices 3. Lack of product

Figure 13. Bar chart of the average number of solved missions in the e-café game.

vers verified whether they completed them on their own.

"marketing" were not solved effectively, but missions in the "sanitation" and "employee training" domain categories were easily solved by the users.

4.3 Evaluation of Usability

The following evaluation of usability for the Beta version of e-café game involved both quantitative and qualitative data collected from questionnaires, interviews, and feedback. The subjects, test processes, and research tools are explained as follows (Tables 4 & 5).

4.3.1 Subjects and Test Processes

A total of 53 participants from the college of business management at a university in Taiwan were invited to take part in testing e-café simulation game .31 of them were female and the other 22 were male; 48 of them were freshman, four were sophomores, and one was a senior. All played the e-café game for the first time. Through feedback from the participants, we identified the needs of the users and revised the simulation game accordingly. Tests and interviews were conducted regarding the content and usability of the game. The entired test process isfinishedin 1 hour.

4.3.2 Test Tools

During the test process, the participants were closely observed and provided with objectives (tasks) in accordance with their progress. They were expected to accomplish each phase of their tasks in accordance with the statements provided by the observers. The participants were expected to complete eleven missions and the obser-

4.3.2.1 Questionnaire on Task Difficulty

The participants first completed the pretest and then the posttest questionnaires. The questions were ranked using a 5-point-Likert scale, with 1 representing *very easy* and 5 representing *very difficult*. This questionnaire comprised 17 questions in four dimensions: attitude, perceived ease of use, intention to use, and perceived usefulness. Questions were ranked on a 5-point- Likertscale, on which 1 represented *strongly disagree* and 5 represented *strongly agree*.

Table 4. E-café online simulation game — usability testing process

Testing process	Research tools
1. Clarifying the purpose of the test	Specification sheet
2. Filling out the information	Consent letter
3. Drawing the concept map before playing	
4. Execution of missions	Mission observation sheet (by the observers) Questionnaire on mission difficulty (by the subjects) Morae (recorded by the observers) PC Webcam
4. Post-test questionnaire (including drawing concept maps after playing)	Questionnaire on user experience
5. Post-test interviews	Interview outline Morae

Table 5. Mission statements and focus of observation

Mission statement	Focus of observation
After entering the webpage, how did you find the introduction to the game?	Whether the subjects understand how to play the game
Please tell me how much capital is required to open an e-café?	Whether the main menu is well designed for the user to follow
Please save your progress and leave the game. Then log in to your account and password and restart the game.	Whether teaching materials are well designed for for usability
Researchers should determine whether the subjects were able to undertake the missions successfully.	Whether the subjects could find out the specific data for each mission from the main menu, and solve problems accordingly
Researchers should observe and record which function button (s) the subjects did not use, and ask afterwards.	Whether the function buttons were easily overlooked by the subjects

4.3.2.2 Interview Outline

The interview questions were as follows:

Q1: Do you encounter any problems when pursuing missions in the game? How do you resolve the problems?

Q2: Do you understand the process of managing a coffee shop better after completing the e-café game?

Q3: Please list the concepts related to business administration that you learned from the e-café game?

Q4: Do you think the e-café game helped you in acquiring knowledge about business administration?

Q5: Would you join classes that conduct simulation games in the future?

4.3.3 Analysis of the Questionnaire on Task Difficulty

The questionnaire enabled determining how the participants felt about each mission (Table 6). For the 11 question items, the mean score was 1.8 (SD = 0.93). The scale of difficulty ranged from 1 (*very easy*) to 5 (*very difficult*). The participants felt that Task 8 was the most difficult to accomplish (M = 2.7), followed by Task 10 (M = 2.2), Task 6 (M = 2.1), and Task 7 (M = 2.1). Task 8 involved adjusting the shift schedule. Task 10 required participants to organize staff training sessions. Task 6 required participants to improve the quality of raw materials. Task 7 required participants to devise a marketing approach to expand the customer base. In Task 5, participants were required to adjust the sales price.

4.3.4 Analyses of Interviews

Analyzing the interviews enabled revealing the ex-

periences of users and identifying areas that were not adequately covered through the questionnaires or observation. The interview analysis pertained to the following questions:

Q1: Did you encounter any problems when pursuing missions in the game? How did you resolve the problems?

A total of 53 participants described the problems they encountered when playing the simulation game. Regarding the game scenarios interface design, the interview results indicates that about 15% of the participants did not

Table 6. Results of the scale of difficulty perceived by participants

Tasks	M	SD
1. Obtain mission	1.5	0.85
2. Complete equipment repair and maintenance	1.6	0.84
3. Placate customers	1.6	1.07
4. Ask your staff to clean up	1.4	0.97
5. Alter prices	1.7	0.82
6. Upgrade the quality of raw materials	2.1	0.88
7. Devise a marketing scheme to expand the customer base	2.1	1.37
8. Adjust shift schedule	2.7	1.25
9. Complete equipment upgrades	1.6	0.84
10. Organize training sessions for the staff	2.2	1.03
11. Change "order-meal" to a "guest area" page	1.1	0.32
Overall	1.8	0.93

M. stands for meanscore ; S.D. stands for standard deviation.

know that the Bottom of staff names on game interface could be clicked to solve a mission. Approximately 5% of the participants wonder why the game scenario of the coffee machine broken could not be clicked for repair action. However, most of these operation problems regarding interface design were resolved after the participants tried several times. Clearly, the simulation game required explaining all of the game functions. Nevertheless, these observations by research team elucidated the needs and expectations of the participants, thus facilitating future improvement of the game.

Q2: Did you understand the process of managing a coffee shop better after completing the e-café game?

Nearly 92% of students (48 out of 53) believed that the e-café simulation game helped them to understand how to manage a coffee shop and acquire relevant knowledge of business management.

Q3: Please list the concepts related to business administration that you learned from the e-café game?

All participants felt that they enhanced their knowledge of concepts related to business administration through playing the e-café simulation game. These concepts included cost control, arranging staff shifts, selecting a location for opening a shop, management of raw materials, equipment repair and maintenance, profit, and procurement. However, a number of other opinions were also expressed:

S1: "It appears to me that hands-on experience would be more helpful."

S12: "I never took any class in business administration before, so I cannot say for sure. As to concepts, I think the most helpful ideas were about management, shift schedules, and the timing of equipment maintenance and repair."

S34: "I believe that cost control and customer satisfaction were dealt with effectively in the game."

Q4: Did you think the e-café game helped you in acquiring knowledge about business administration?

Approximately 85% of the participants (45 of the 53) believed that the e-café simulation game complemented their business-administration curriculum.

Student S6 felt that if this game were played during class, they would not need to peruse reading materials. S38 said: "I have never taken any classes in business administration; however, I am left wondering if this would be too

simple to fit into the real world. For example, human resources appeared too simplified. Raw materials, prices, and the quality of materials appeared more authentic."

Q5: Would you join classes that conduct simulation games in the future?

Approximately 94% of the participants would join classes that use simulation games in the future, because this learning method increased their interest in learning and enhanced their learning performance and efficiency.

5. Evaluation Data from Studnents' Perspectives

In order to understand students' perspecitive towards game-based learning, we implementeda 5-point Likert scale questionnaire (PGBL) with 17 items and the Cronbach's alpha of PGBL is .854 and acceptable.

The findings indicated that students were overall satisfied (the total average score in each factor was higher than 3.5). Table 7 indicated that Factor 1, "consistent with the curriculum," received an average score 4.01; Factor 2, "learner engagement," received an average score of 4.22; Factor 3, "effective learning," received an average score of 3.74; Factor 3, "ease of use," received an average score of 4.07. Moreover, the feedback and interview data indicated that most students thought the five domain categories in the game, "sanitation", "human affairs", "employee training", "marketing", and "production" represented basic business-management knowledge and were consistent with their curriculum. Regarding the ease of use, numerous users indicated that most of the game's interfaces and design aspects were intuitive. However, the mean scores of Question 3 in Factor 3 are below 3.5, and, the data from the interviews with students indicated that the concept of marketing strategy was not sufficiently developed in the e-café game. In a word, the current Beta version of the e-café simulation game proved to be stable and applicable for students, enabling them to learn concepts of business management effectively.

6. Conclusions

The design of serious games for education is a complex task in which designers need to create products that engage the users and provide an engaging leanring ex-

Table 7. The mean socres of the questinniare from studetnts' perpectives

Item No.	Mean	SD	Total average scores
Factor 1: Match to the curriculum			
Question 1	3.79	0.81	
Question 2	4.02	0.72	4.01
Question 3	4.42	0.85	
Question 4	3.82	0.92	
Factor 2: Learner engagement			
Question 1	4.63	0.71	
Question 2	4.25	0.79	4.22
Question 3	3.78	0.93	
Factor 3: Effective learning			
Question 1	3.93	0.83	
Question 2	3.84	0.91	
Question 3	3.35	0.86	3.74
Question 4	3.69	0.69	
Question 5	3.91	0.78	
Factor 4: Ease to use			
Question 1	4.36	0.83	
Question 2	3.82	0.72	
Question 3	3.53	0.96	4.07
Question 4	3.98	0.85	
Question 5	4.62	0.68	

M. stands for mean score; S.D. stands for standard deviation.

perience, integrating gameplay features with educational material. Moreover, as with any software product targeting a broad users, the usability of the resulting games is important.

In this research, we proposed a simulation game called e-café operation, which was developed by DBR approach and tested by Business school college students. The e-café simulation game was designed to enable users to familiarize themselves with the domainknowledge of business management, in the categories of sanitary, human affairs, employee-training, and production management as well as marketing. According to the analysis of students' game-playing records, the instructors evaluated the students' learning situations to enhance their subject knowledge. In addition, the game designers received feedback from users on the quality and performance of the simulation game.

Based on the results of other usability inspection studies, in the content of the study presented in this pa-

per, the profiles of the participants and the testing conditions, the results with regards to quality merits are quite acceptable. It is worth mentioning that during the steps of development and implementation of the DBR approach provide sufficient details to detect problems of interface sign to design/redesign interface sign to make them more intuitive for end users and to improve usability.

The study presented certain limitations that used to be acknowledged. Overall, the tests were conducts with a limited number of users, so conclusions are limited in scope until more tests with larger numbers of users can be performed. We believe that these results point toward the need to ponder the design and development of e-café game as a significant approach to ease access to simulation courseware. This test for Beta version of e-café game was undertaken by 54 Business school college students, however, we believe the results recommend that further testing is conducted used in the test, as well as the cooperation of business practitioners. Furthermore, the analysis of qualitative data (participant's responses in interview) is generally subjective as it depends on people's assumptions and inferences. However, to avoid bias in the analysis, the results were discussed with experts and a review process was also carried out.

References

[1] Pasin, Federico and Giroux, Hélène., "The Impact of a Simulation Game on Operations Management Education," *Computers & Education*, Vol. 57, pp. 1240–1254 (2011). doi: 10.1016/j.compedu.2010.12.006

[2] Lin, F. H., Kinshuk and Dutchuk, M., "Multi-agent Architecture for Integrating Adaptive Features in Immersive 3D Virtual Learning Environments," Proceeding of the 6th International Workshop on Mobile and Ubiquitous Learning Environment, pp. 33–35 (2009).

[3] Clark, D. and Linn, M. C., "Designing for Knowledge Integration: The Impact of Instructional Time," *The Journal of Learning Science*, Vol. 12, No. 4, pp. 15–142 (2003). doi: 10.1207/S15327809JLS1204_1

[4] Chang, C. S. and Huang, Y. P., "Usability Assessment of E-café Simulation Game-based Material," Proceedings of 7th International Conference on E-Learning, IADIS, Taiwan, Taipei (2013).

[5] Charsky, D., "From Edutainment to Serious Games: A Change in the Use of Game Characteristcs," *Game and Culture*, Vol. 5, pp. 177–198 (2010). doi: 10.1177/1555412009354727

[6] Tompson, G. H. and Dass, P., "Improving Students' Self-efficacy in Strategic Management: The Relative Impact of Cases and Simulations," *Simulation and Gaming*, Vol. 31, pp. 22–41 (2000). doi:10.1177/104687810003100102

[7] Bai, H., Pan, W., Hirumi, A. and Kebritchi, M., "Assessing the Effectivenss of a 3-D Instructional Game on Improving Mathematics Achievement and Motivation of Middle School Students," *British Journal of Educational Technology*, Vol. 43, No. 2, pp. 993–1003 (2012). doi: 10.1111/j.1467-8535.2011.01269.x

[8] Cheng, M. T., She, H. C. and Annetta, L. A., "Game Immersion Experience: Its Hierarchical Structure and Impact on Game-based Science Learning," *Journal of Computer Assisted Learning*, pp. 232–253 (2015). doi: 10.1111/jcal.12066

[9] The Design-Based Research & Collective, "Design-based Research: An Emerging Paradigm for Educational Inquiry," *Educational Researcher*, Vol. 32, No. 1, pp. 5–8 (2003) doi: 10.3102/0013189X032001005

[10] Collins, A., Joseph, D. and Bielaczyc, K., "Design Research: Theoretical and Methodological Issues," *The Journal of the Learning Science*, Vol. 13, No. 1, pp. 15–42 (2004). doi: 10.1207/s15327809jls1301_2

[11] Pardo-Ballester, C. and Rodri'guex, J. C., "Using Design-based Research to Guide the Development of Online Instructional Materials," In C. A. Chapelle, H. G. Jun, & I. Katz (Eds.), Developing and evaluating language learning materials. Ames, IA: Iowa State University. pp. 88–102 (2009).

[12] Yutdhanna, S., *Design Based Research in Call*, in J. Egbert and G. M. Petrie (eds), CALL Research Perspectives, Mahwah, NJ: Lawrence Erlbaum and Associate, pp. 169–178 (2005).

[13] Hardash, J., Hamilton, B. and Dunn, M., "GPS III Independent Program Assessment Lessons Learned - From IPA Failure to Mission Success," Proceeding of IEEE Aerospace Conference, MT, U.S.A, Mar. 07–14, pp. 1–10.(2009). doi: 10.1109/AERO.2009.4839717

[14] Zhang, G., Xiong, F. and Luo, Q., "Research on Mobile English Assistant Learning System Based on Wireless Communication," The Proceeding of 2nd International Conference on Pervasive Computing and Applications, pp. 689–692 (2006).

[15] Hong, N. S., McGee, S. and Howard, B. C., The Effect of Multimedia Learning Environments on Well-Structured and Ill-structured Problem-solving Skills, ERIC: ED474443 (2000).

[16] Wang, F. and Hannafin, M. J., "Design-based Research and Technology-enhanced Learning Environments," *Educational Research & Development*, Vol. 53, No. 4, pp. 5–23 (2005).

[17] Perterson, R. and Olney, I., "Usability Evaluation in a Multiphase, Exploratory Design-based Research Study of an Online Community for the Practice of Special Education in Bulgaria," Proceedings of ED-MEDIA 2009: World Conference on Educational Multimedia, Hypermedia & Telecommunications. Chesapeake, VA (2009).

[18] Hartson, H. R., Andre, T. S. and Williges, R. C., "Criteria for Evaluating Usability Evaluation Methods," *International Journal of Human-Computer Interaction*, Vol. 15, No. 1, pp. 145–181 (2003). doi: 10.1207/S15327590IJHC1304_03

[19] Rubin, J., Chisnell, D. and Spool, J., *Handbook of Usability Testing: How to Plan, Design, and Conduct Effective Tests*, 2nd edition. In: Wiley Publishing (2008).

[20] Rohn, J. A., Spool, J., Ektare, M., Multer, M. and Redish, J. G., "Usability in Practice: Alternatives to Formative Evaluations-evolution and Revolution," In Proceedings of Conference on Human Factors in Computing Systems, Minneapolis, Minnesoda, U.S.A. (2002).