MOBILE GAME FOR LEARNING BACTERIOLOGY

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ABSTRACT

This paper treats serious games. Recently, one of the game genres called serious game has become popular, which has other purposes besides enjoyments like education, training and so on. Especially, learning games of the serious games seem very attractive for the age of video games so that the authors developed a mobile game for learning bacteriology as one of the achievements of their research project. In this paper, the authors introduce the game and show evaluated results about its learning effectiveness.

KEYWORDS

Serious games, Mobile learning, Educational contents, Bacteriology

1. INTRODUCTION

The serious game is one of the game genres, whose name is originally employed by Clark C. Abt, a social scientist, in his literary work “Serious Games” published in 1970 [1]. Generally, serious games mean a certain kind of games that have other purposes besides enjoyments. As written in [2], the digital game is effective for the education and the communication, and then recently, the word “serious game” has become popular gradually because many serious games have been developed and such services have been provided so far, e.g., an education game [3] and rehabilitation games [4-5]. In Japan, a game "Brain Age" of Nintendo DS produced in 2005, whose purpose is to train the brain through the game play, was one of the popular serious games. After that, the word “serious game” has become more and more popular in Japan. As for the academia, several international research conferences on serious games were held in many countries. In this way, the research on serious games has also been becoming significant.

We are interested in serious games for the education, learning or training because we have a certain research project about serious games collaborated with the faculty of medicine of our university and we want to know how such serious games are effective practically for the education or learning in the higher education. Then, we developed one serious game which helps students to learn bacteriology. We also evaluated the effectiveness of the game through the user experiments. In this paper, we show such evaluation results besides introduce our serious game.

2. GAME DEVELOPMENT

2.1 Planning

The planning of a game is one of the important processes for making it enjoyable before actually implementing it. For developing our serious game, a mobile learning game of bacteriology, we made discussions about its design and story for increasing the learning effectiveness besides the enjoyment.

One of the important things in bacteriology is to learn bacterial dyeing methods and suitable treatments for bacterial infection persons. In our game, we decided to focus on the latter one. However, we thought that a simple quiz game is not enough as an enjoyable game. As a game type, we adopted RPG typed game in that a player can reach to the goal of its story by defeating the bacteria as enemies and by selecting some commands to perform suitable treatments. The bacterial shapes and colors were designed to be deformed from real ones in order to attract players as shown in Figure 1 (Left).

Figure 1. Images of game components, illustration of vibrio cholera (Left), contents of the log (Center) and contents of the hint (Right).

A human has the immune strength against external bacteria like the good bacteria and white corpuscles by nature. Then, we adopted the system that these good bacteria actually fight with enemy bacteria, and we choose the command, which is using some antimicrobial drugs or performing symptomatic therapy, as a support. If you use the suitable drug, that damage will become little, but if you use an unsuitable drug, that damage will become much. By using symptomatic therapy command, the good bacteria will recover from the damaged state because that therapy aims at the relief of bad condition. These informations are recorded in the log as shown in Figure 1 (Center) located in the lower part of a screen when the action is taken.

Because it is very difficult for players without any medical knowledge to take adequate actions, we decided to give some hints to a player as shown in Figure 1 (Right) by his/her touching the enemy bacterium twice on a screen. Although a player cannot check some items at the beginning of a game because they are hidden, the player will reveal them by consuming his/her experiment points (EXP) which are gained by the battle during the game. A player can also raise the levels of some parameters that good bacteria have by consuming EXP. EXP is also used for calculating the game score. Once a player meets some bacteria, the information about them will be recorded on "pictorial book" that can be checked later.

2.2 Implementation

We decided to make this serious game as an application of a smart phone or a tablet PC for enabling many people to play the game. However, we also had to decide its platform, i.e., OS because there are several kinds of OS for a smart phone, e.g., Android, iOS, etc. Then, we decided Android as its platform because of the below. Android OS is supported by Google Inc., and that target is a mobile device, such as a smart phone and a tablet PC. Android has ranked as 1st of the share of the smart phone's OS in the world [6]. That share in Japan has also accounted for about 50 percent of all smart phone platforms.

We used Unity for developing our serious game. Unity is a game engine produced by Unity Technologies and it has Integrated Development Environment (IDE). One of the reasons why we adopted it is that it enables to develop multiplatform applications. Using the same source codes of Unity, we can develop a game of not only Android but also iOS. The other reason is that Unity is very easy for everyone to learn how to use.

3. EVALUATION OF GAME

3.1 Evaluation Methods

We evaluated how much our game is effective for the bacteriology study through the following procedures: P1: Pre test, P2:Playing the game, P3: Post test, P4: Questionnaire

The pre and post tests are four multiple choices questions to answer the correct treatment for a bacteria and its patient condition written in a paper. There are eight questions (Test1-1) in the pre test, and there are the same eight questions (Test1-2) and other eight questions (Test2) in the post test. These questions are chosen from the patient conditions appear in the game. We asked subjects to play the game until its end in around 40 minutes. The contents of the questionnaire are the following five questions. Q1 to Q4 are scored by -2 (negative answer) to 2 (positive answer).

Q1. Is the motivation to study bacteriology enhanced after playing the game?
Q2. Are there any feelings that bacteriology could be studied by playing the game?
Q3. Could you play the game in the positive feeling?
Q4. Do you wish to play the game again?
Q5. Please give some comments, e.g., improvement points and unclear aspects about the game.

The subjects are four students who are not medical department students and have not studied bacteriology. Their average age is 23.3 years old. All of them are male. Finally, we checked the difference between the average score of the pre test and that of the post test. We also checked answers of the questionnaire to evaluate the learning effectiveness of the game.

3.2 Evaluation Results

Results of the tests are shown in the left part of Figure 2. In the pre test, the average score, the number of correct answers, of Test1-1 is 2. Since the subjects are students who have not studied bacteriology, their scores of Test1-1 are reasonable. Although one subject has a high score, this seems an accidental score. Contrarily, in the post test, the average scores are 4.5 of Test1-2 and 4 of Test2. As for the variance, in the pre test, the variance of Test1-1 is 3.5. Contrarily, in the post test, the variances are 0.25 of Test1-2 and 0.5 of Test2. From these results, it can be said that our game is effective for bacteriology study.

Results of the questionnaire are shown in the right part of Figure 2. According to the average score of Q1, all of the subjects are not medical department students, so the motivation cannot not increase so much. The result of Q2 shows that almost of the subjects felt that they could learn actually. The results of Q3 and Q4 inform us the subjects could play the game positively and they want to play it again. Finally, the answers of Q5 indicate that it was difficult to memorize the names of bacterium with their patient conditions and treatments together because they were shown illustrations of bacterium. One subject said some of the bacteria illustrations were not suitable for their images.

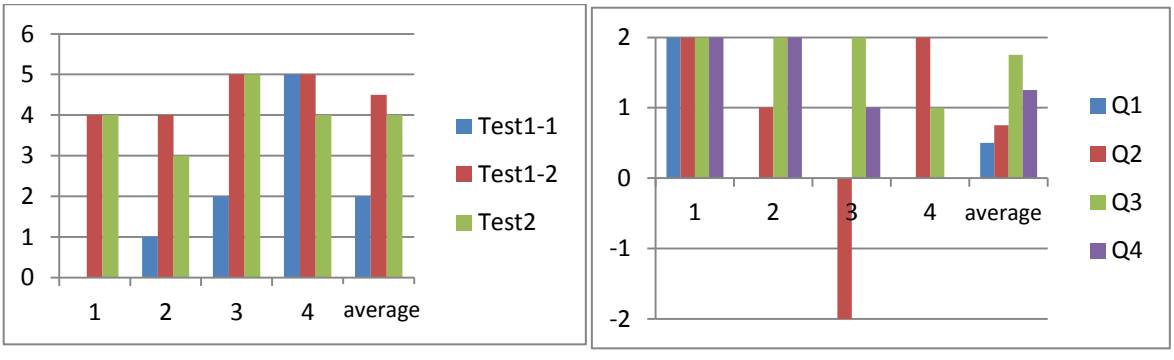

Figure 2. Test results whose vertical axis is the number of correct answers and horizontal axes are subjects and the average score (Left), and questionnaire results whose vertical axis is the score of answers and horizontal axes are subject and the average score (Right).

4. CONCLUDING REMARKS

In this paper, from the experimental results, we clarify that our serious game is effective for bacteriology study. Moreover, the comment says that students without medical knowledge also want to play the game again is caused from the goodness of the game story and the deformed illustrations of bacterium. As for the motivation to study the bacteriology, a good result was not obtained in this experiment. However, it may not mean that our game cannot increase the motivation because the subjects are not medical department students so that they are originally not interested in medicine, and one of them answered that his motivation was increased and there was no subject who answered no. We will verify this point by asking medical department students to play the game in the near future.

Moreover, the problem is revealed that patient conditions and their treatments opt to be linked to illustrations of bacterium instead of their names. Originally, we adopted the deformed illustrations to make it easier for players to remember the characteristics of bacterium but it could not work well. Although bacteria names are stored in the log or the hint, players may not pay their attention to them. Therefore, as one of the improvement points of the game, such information should be constantly displayed on the upper part of a screen. There was indication that bacteria illustrations did not match to the shapes and colors of real bacterium. So, we will improve the illustrations as one of the future work. The number of bacterium appear in the game is 19, and one symptom case is only prepared for each bacteria although desirable treatments are depending on a patient state, such as sex, age, degree, and so on. So, we will prepare more symptom cases of bacterium for the next version of the game. These described above are our future work.

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