Pilot Study of an Educational Turn-Based Online Game for Formative Assessment in E-Learning Environment

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Abstract. This study proposed an educational turn-based online game, called tic-tac-toe quiz (TRIS-Q), for formative assessment in a research-developed e-learning system targeting knowledge about energy education for elementary students. This game combines multi-player tic-tac-toe game and online test. To stimulate students' motivation toward the online self-assessment, this study proposed a new game rule in TRIS-Q. When players take their turn in game, they must respond to a random multiple-choice quiz which was constructed according to the e-learning contents. Also, the victory of game will be influenced by their response. According to the research findings, after using online learning and TRIS-Q, students' learning effectiveness was significantly enhanced. Most of students had positive attitude toward the game-based assessment.

Keywords: Turn-based online game, game-based assessment, formative assessment, e-learning.

1 Introduction

Assessments often can be divided into summative assessment and formative assessment. Summative assessment means the test after the finish of the whole learning activity. The purpose is to evaluate students' total learning effectiveness toward certain teaching material and their grades [1]. On the other hand, formative assessment means the evaluation in learning. Besides grading or evaluating learning effectiveness, it is mainly adopted to provide learning feedback, enhance learning performance and improve learning [2]. Thus, formative assessment is important for teachers and students. According to the outcomes of students' formative assessment, teachers can improve the instruction and conduct remedial instruction, while students can recognize learning flaws and have self-improvement.

In traditional classroom, paper-and-pencil tests were treated as the tool of formative assessment. However, with the maturity of network technology and prevalence of online learning environment, online formative assessment has been widely applied to e-learning courses. Online assessment is convenient test and learners can have the assessment without the limitation of time and space. Through online tests, it can provide learners with instant feedback [3]. Also, teachers can immediately understand students' learning progress and learning performance [4]. Thus, online assessment can

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help teachers properly manage and guide learners with inferior learning effectiveness, and enhance learners' interaction and feedback in self-directed learning to properly have self-management and self-improvement.

However, although online assessment is almost the essential functions in most e-learning courses, it cannot be ensured that every e-learner has the intention to actively conduct online formative assessment repeatedly. Hence, with current prevalence of game-based e-learning and in order to enhance learners' motivation to use online formative test, game-based formative assessment was proposed by some studies. For instance, Wang [5] applied a web-based quiz-game-like formative assessment in an e-learning environment. According to the Wang's research finding, the e-learning effectiveness with game-based formative assessment was better than the one with normal web-based test. Also, the game-based formative assessment enhanced online learners' intention to actively do self-assessment.

To date, the multi-player online games (MOGs) have become the dominant form of computer games. However, there are few research studies using online game for the formative assessment on e-Learning. Based on the above rationale, this study attempted to develop a turn-based online game, called tic-tac-toe quiz, for formative assessment in a research-developed e-learning system targeting knowledge about energy education for elementary students. It aimed to enhance effectiveness of e-learning and students' motivation to use online formative assessment.

2 The E-Learning System with Turn-Based Online Game for Formative Assessment

According to the curriculum guidelines in Taiwan, this study developed an e-learning system targeting knowledge of energy education suitable for elementary schools. When e-learners log in this e-learning system, they can start self-directed online learning activity through reading online learning contents related to energy knowledge. Noticeably, based on the learning contents, this study developed a turn-based online game, called tic-tac-toe quiz (TRIS-Q), in the system for learners to have online self-assessment at any time. The TRIS-Q combines online test and multi-player tic-tac-toe game. Students will see a game lobby shown as Figure 1 after logging in the game. Players can input texts here to interact with others, and join a tic-tac-toe game where is waiting for the second player, or create a new game and wait for the second player. As soon as two players join a game, the tic-tac-toe game starts shown as Figure 2. The game rule is similar to the traditional tic-tac-toe game, that is, the first person to place three tokens in a row, column, or diagonal is the winner. However, this game changes some rules of traditional tic-tac-toe. That is, when a player takes his turn, the game will randomly pop a multiple-choice quiz which was constructed according to the e-learning contents, shown as Figure 3. Since the victory always goes to the one who makes the first move in tic-tac-toe, in order to increase the difficulty and playfulness, the game rule is slightly modified. If the player responses the right answers, he can draw his token; otherwise he will draw his opponent's token. Thus, the new game rule could stimulate participants to seriously answer the questions in TRIS-Q. Also, this

game provides every student's history of answering quizzes for the feedback of self-assessment. Students can obtain feedback and revise mistakes through checking the personal answering history. Moreover, this game also provides the high score list which presents the top ten player scores and names.

Fig. 1. The game lobby of game-based formative assessment

Fig. 2. Screen snapshot of playing online tic-tac-toe

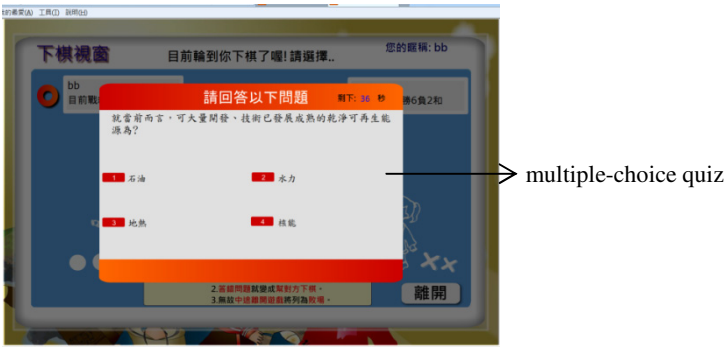

Fig. 3. Screen snapshot of answering quiz when playing game

3 Research Design and Finding

In order to find primary effectiveness of online game-based formative assessment, this study conducted quasi-experiment with pretest and posttest of single group and questionnaire survey to probe into elementary students' change of energy knowledge literacy and learning perception after using the online learning system. This study treated 23 Grade 5 students in one class of one elementary school at Chiayi County as subjects to conduct two-week online learning activity. Students were asked to use the e-learning course for two sessions (40 minutes each) evenly spread out over two weeks in computer classrooms. Moreover, within these two weeks, students also can proceed e-learning after school at any time. Before and after the experiment, the researcher conducted self-designed energy knowledge test (20 multiple choice questions. Difficulty and discrimination are 0.61 and 0.42 respectively) on the subjects. After the experiment, learning perception questionnaire (25 items of 5-point Likert-type scale, Cronbach α is 0.97 and there is one open-ended question) was conducted on subjects in order to find students' perceptions after using online game-based formative assessment.

According to the findings, this study found that before participating in this online learning, the subjects have average score of energy knowledge test as 45.43 and after the learning, their average score is 60.22. Based on t test of paired samples, scores of pretest and posttest reach statistically significant difference ($t=2.704$, $p=.010$). Thus, it means that the e-learning effectiveness of elementary students' could be enhanced through the online game-based formative assessment. Moreover, as to students' perception after using online game formative assessment, based on 5-point scale (strongly agree is 5 points, etc.), it demonstrates that averages of all questions are above 3.5. Thus, all students have positive attitude toward the tic-tac-toe quiz. Their positive comments are as follows: "the design of the game is good", "it was super cool", "it was fun", "I expected such game and I learned the principle and energy. I want to play it again", etc.

4 Conclusion and Future Work

This study proposed a game-based formative assessment in e-learning environment upon multi-user online game. The game is based on tic-tac-toe many young students are familiar with. In the game, e-learner must respond to one question related to the learning contents for students' game-based assessment. Thus, students can recognize their e-learning effectiveness in the game, enhance motivation to use online formative assessment and improve learning effectiveness. According to the findings, after using online learning and game-based assessment, students' learning effectiveness was enhanced. Most of students had positive attitude toward the game assessment. They suggested that it is easy and fun to operate the game and it increases their motivation to use online assessment. However, this study is a primary experiment and the findings should be validated by future experimental design with control group. Future studies can include single-player tic-tac-toe assessment game in online learning system. Thus,

students can choose to play online or play with the computer, thereby satisfy students' preferences. The difference of learning effectiveness of different game assessment models can also be compared in the future.

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