# Usability of Story in Context-Aware Mobile Educational Game

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***Abstract:*** *A context-aware educational game-based mobile application, CAMEG, can generate inquiry-based learning activities for the learners according to their needs (or the courses they are taking at that moment) and allow them to learn through role play in a game world that integrates physical environment with the challenges and excitement of game play, had been developed in 2010. Its usability was also verified. To make the generated learning activities more attractive to the learners and make the mobile game become an immersive learning environment for the learners, a new version of the game, CAMRPG, was developed in 2011 to generate stories with narrative elements to decorate the original generated learning activities. This research tries to evaluate the effectiveness of generated stories in the mobile educational game by comparing the usability analysis we had done last year, to see if there is any significant difference of learner perceptions toward the two games - CAMEG and CAMRPG.*

**Keywords:** Context-aware, Mobile Educational Game, Narrative, Usability Analysis, Role Play Game

## 1. Introduction

In 2010, the research team developed a context-aware mobile educational game called CAMEG (Lu, et al., 2010a, 2010b). CAMEG can generate a series of learning activities (i.e., a learning activity chain) to make the learners interact with specific real (e.g., projector, rest room, pine tree, etc.) and virtual (payroll system, business policy, E-Commerce course, etc.) objects in the real world. The series of learning activities are automatically generated according to learner's learning history, surrounding context (i.e., learning objects associated with the chosen role that the learner wants to play and the chosen learning theme, learner's location, etc..) for the learner. Multi-agent system design principle has been adopted into the game, with multiple agents' help, the game can be running on different smartphones easily (Lu, et al., 2011a).

However, most of the existing research on mobile learning and game-based learning, including the abovementioned CAMEG research, focus on specific discipline or curriculum in formal educational and on-the-job training settings (i.e., workplace, school campus, museum and historical site) only. These games will be boring if it just asks learners to do the activities one-by-one. Few research talks about how to design the contents of mobile educational games and make learners feel interesting and want to play the game continuously.

In order to make the context-aware mobile role-playing game interesting and engaging to uses, this research team takes narrative elements into considerations. The research team applies the narrative theory to enhance the CAMEG in order to make learners feel that they are living in the game world and role play an actor, explore the game world, complete the quests, and learn something. At the end, the enhanced mobile educational game with stories - Context-Aware Mobile Role Playing Game (CAMRPG for short) has completed in 2011.

In 2010, a usability test had been conducted for the CAMEG, the results indicate that male and female participants feel quite differently to the effectiveness of the proposed mobile educational game, in particular, female participants' responses to the perceived effectiveness and satisfaction toward the CAMEG are more positive than male participants

(Lu, et al., 2011b). The 2010 results are align with other researchers' findings, which are males tend to feel educational games are boring but females have more positive perceptions toward educational games.

This research has a question to be examined - does having the story in the mobile educational game make the game more appreciated by learners? A pilot is then conducted. In this pilot, a compact questionnaire derived from previous CAMEG study is used to gather learners' perceived effectiveness, efficiency, and satisfaction toward the CAMRPG; and statistical analysis method such as independent T-test is used to find the answers for the research question.

## 2. Pilot Design and Data Collection

In the beginning, the researchers introduced the CAMRPG and did a demonstration in a Management Information System (MIS) class of the department of Information Management (IM), National Kaohsiung First University of Science and Technology (NKFUST), Taiwan. The researchers explicitly told the students that there is no compensation, reward, or recognition for anyone who participate this study as well as nothing will happen to the students who do not want to join the study. At the end, 55 undergraduate students (ages range 21-22 years old) were recruited, including 31 males and 24 females.

The experiment environment of the pilot took place in three laboratories in the fifth floor of teaching building E of the university. Due to all participants were taking undergraduate level MIS course at that moment (June, 2011), the researchers took MIS course contents and concepts into the game and built a virtual science park in the fifth floor of teaching building E where many famous IT business and company reside in for participants learning MIS concepts while playing the CAMRPG.

There participants were grouped into 23 teams with 3 to 4 students per team and were asked to make appointments with the researchers for playing the CAMRPG. All students had 20 minutes to play the game with the smartphones the researchers prepared at the authentic learning environment. After they played the game, they were asked to fill up the usability questionnaire in order to gather necessary data for analyzing and verifying the proposed research questions.

We use usability to evaluate if the proposed system can help users learn in the specific environment and satisfy users' needs. A revised usability questionnaire has been made based on the usability analysis results we had in 2010 (Lu, et al., 2011b). The revised questionnaire contains eleven five-point Likert-scale items (5 for "strongly agree" to 1 for "strongly disagree") which may affect a system's usability, i.e., effectiveness, efficiency, and satisfaction. All items exist in the original questionnaire. The validity of these items was established by a review of three experts in educational technology field. The Cronbach's alpha value for the revised questionnaire is 0.840 with 2010's data set indicating that the questionnaire (and its items) can be seen as reliable due to its internal consistency is good enough (i.e., exceeds.0.75).

In order to make sure that the revised questionnaire maintains good reliability for further quantitative data analysis, we also test its reliability with both 2011's data set and the mixed-up of the two data sets (i.e., the data set of 2010 and 2011). The Cronbach's alpha values are 0.873 (for 2011's data set) and 0.853 (for the mixed-up data set) showing that we can use the revised questionnaire to do the follow-up analysis to find out the answers of the two research questions.

## 3. Data Analysis and Results

All data from 92 participants (include 37 from 2010's study and 55 from 2011's study) are used for doing statistical analysis and independent T-test. From the statistics point of view, all participants have positive perceptions toward the games they played as Table 1 lists. However, it seems that the 2011 group's participants have perceived the effectiveness of the game they played more positively as well as satisfying with the game they played a little bit much

more than the participants in 2010 group. The results lead us to a positive answer for our research question - does having story in the mobile educational game make the game more appreciated by learners?

| | Group | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Effectiveness | 2010 (CAMEG) | 37 | 3.8784 | .66044 | .10858 |
| | 2011 (CAMRPG) | 55 | **4.2364** | .56809 | .07660 |
| Efficiency | 2010 (CAMEG) | 37 | **4.2230** | .53289 | .08761 |
| | 2011 (CAMRPG) | 55 | 4.0591 | .53568 | .07223 |
| Satisfaction | 2010 (CAMEG) | 37 | 3.8811 | .61003 | .10029 |
| | 2011 (CAMRPG) | 55 | **3.9818** | .50077 | .06752 |

*Table 1.* Statistics data of the perceived usability for two groups: CAMEG and CAMRPG group.

With independent T-test, tthere is significantly different perceived effectiveness toward the games the participants in the two groups played, but no significant difference on the perceived efficiency and satisfaction between the two groups for the two games. This finding further shows us that having stories in the mobile educational game doesn't only make the participants have higher satisfaction towards the game, but also increase their perceived effectiveness of the game.

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | |
|---|---|---|---|---|---|---|---|---|
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference |
| Effectiveness | Equal variances assumed | .944 | .334 | -2.775 | 90 | **.007*** | -.35799 | .12900 |
| Efficiency | Equal variances assumed | .732 | .394 | 1.442 | 90 | .153 | .16388 | .11366 |
| Satisfaction | Equal variances assumed | 1.503 | .223 | -.866 | 90 | .389 | -.10074 | .11633 |

*Table 2.* Independent T-test to examine the different perceptions toward the two games.

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