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Applying Multiplayer Online Game in Actionscript Programming Courses for Students Doing Self-Assessment

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Abstract: This research applies a web-based multiplayer online game to motivate students doing self-assessment when they are studying. The experiment is conducted in the first and second year undergraduate programming language courses in Taiwan. Within the multiplayer online game, students can explore the game world, chat with classmates, and solve quests. The quests in the game are self-assessment items, however when the quest items are presented in game form, students feel they are not taking quiz but playing. We collect students' demographic information and their game-play log to evaluate the effectiveness of such multiplayer assessment game. The results show that gender and having internet at rental place do influence student's intention to play the game. Students who have better academic achievement (i.e. higher scores) also have much more willing to play the game during the semester.

Keywords: Educational game, online game, multiplayer, self-assessment, actionscript, programming language

1. Introduction

Many researchers focus the educational potential of multiplayer games in recent years (Herz, 2002; Foreman, 2003). A number of research put efforts in designing games for educational purpose and applying game elements to learning activity design (Bueno, Chacon, & Carmona, 2008; Chang, Wu, & Heh, 2008; Olazar, 2007), at meanwhile, very few attempts of using multiplayer online games to assess student's programming skills.

This research uses a web-based multiplayer online game to assess its efficiency. Section 2 illustrates the features of the assessment game. The experiment design is described in Section 3 and Section 4 shows the experiment results. At the end, Section 5 makes a brief summary and talks about possible future works.

2. The Assessment Game

Chang & Kinshuk (2010) have developed a web-based multiplayer online game to assess student's Java programming knowledge and skills. After players signed in the game, they can see the game world and user interface as Figure 1 shows. The game world is constructed as a set of tiles, each tile has different attributes representing different geographical features (in the world map) and buildings (in the village map). In order to enhance the sense of exploration in the game, the game world is initially hidden from the players (Graven & MacKinnon, 2006). As the players move around the game world, the terrain features of nearby tiles are revealed.

Players can choose various services and pick-up quests from vendors and NPCs (Non-Player controlled Characters) in the game. After players completed the quest by returning the correct quest item (i.e., the program's output and code pieces) back to the NPC, the NPC offers them gold pieces and experience points as reward. The quest types in this game are greeting quest, delivery quest, true/false quest, multiple-choice quest, fill-in-the blank quest, and coding quest.

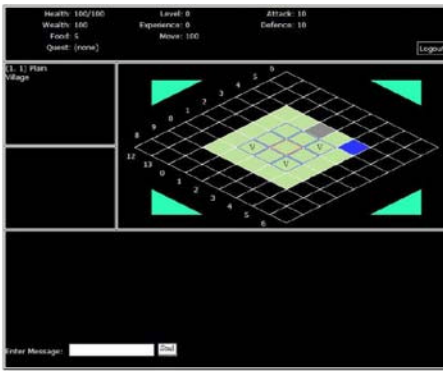

Figure 1. The assessment game

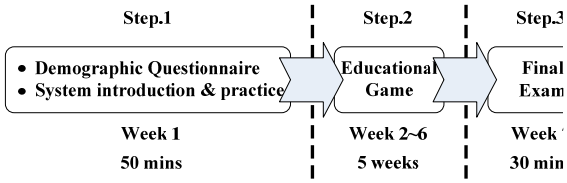

Figure 2. Experiment Flow

3. Experiment

Experiment Design

The experiment courses are the basic programming language learning courses in Department of Digital Design, which implies that all students in these two courses are non-computing relevant school students. These two courses teach Flash Actionscript for freshman and sophomore. Figure 2 shows the flow we designed for this experiment. The experiment starts at one week after the mid-term exam and we take the exam as pre-test. At Stage 1, we ask students to complete the demographic questionnaire and introduce the game to them by demonstrating how to play the game. Students then have 10 minutes to play the game for trial purpose. At Stage 2 (i.e., 2nd to 6th week), the students can play the game anytime they want freely for five weeks. Stage 3 is the post-test, again, we use the final exam directly.

Participants

There are 64 students in the freshman programming language course and 56 students in the sophomore programming language course. After removed those students who didn't complete the questionnaire at Stage 1, 74 students remained (including 28 males and 46 females). Beside gender, the demographic questionnaire also collects: (1) age, (2) living place (i.e., live at home and rental place), (3) have internet at rental place, and (4) have internet at home.

Hypotheses

Most of non-computing relevant school students have less interest in learning programming language and have worse learning outcome. This research uses the multiplayer online game and quests for students self-assessing their programming concepts and skills, including program structure, operators, and Actionscript function usage. If students have interests in

playing the game, they can review and practice the programming concepts they have learned in the classroom by solving the quests. With these thoughts, we have two hypotheses before doing the experiment:

- H1: The demographics will affect students playing the game
- H2: The game-play will affect students' academic achievement of this course

Data Collected

The game-play data we collected in this experiment are:

- Number of Map Opened: The number of map tiles opened by players. The player who has opened more tiles may indicate that s/he likes to explore the game world, who probably is an explorer in Bartle's player style (Bartle, 1996).
- Number of Quest Taken: The number of quests the NPCs gave to the players during Stage 2 in Figure 2. More quests the students taken, more practices they possibly done.
- Number of Quest Solved Correctly: The number of quests solved correctly by the players. The data can help us know how many quests the students have tried and solved correctly in the game, i.e., sort of their academic achievement but only in the game.
- Experience Points: The final experience points which the players got from solving quests. The player who got more experience points usually means s/he has solved more quests. In some circumstances, the player may get more experience points by solving more difficult quests. In this experiment, coding quests give the students more experience points than the multiple-choice and the fill-in-the-blank quests. .

The learning performance data are:

- Mid-term Exam Marks: Student's mid-term exam marks, the maximal marks they can get are 31.
- Final Exam Marks: Student's final exam marks, the maximal marks they can get are 31.
- Semester Score: Student's final score for this course. The maximal score is 100.
- Improvement: Student's learning improvement from mid-term exam to final exam.

4. Results and Data Analysis

H1: The demographics will affect students playing the game

There are 60 students (81.1%) who didn't live at home but rent a room near the school, 59 of them (98.3%) have computer at the rental place and 54 of them have Internet there. All the students who live at home have computer and 13 of them have Internet.

Table 1. The statistics of having computer and Internet at home and rental place

Living Place	# of Students	Has Computer	Has Internet	No Response (for Internet)
Home	14	14 (100%)	13 (92.8%)	0 (0%)
Rental Place	60	59 (98.3%)	54 (90%)	3 (5%)

To test the first hypothesis, we use ANOVA to see if there is significant difference between the factors in demographics and the factors in the game-play. At the beginning, we check if there is gender difference in students playing the game. The analysis shows that gender has significantly influence to the game-play ($F(1, 72) = 5.435$, $p < 0.05$). We also check if living places affect the students playing the game. The analysis tells that living place has no significant influence to the game-play ($F(1, 72) = 0.609$, $p > 0.05$).

Having internet for students who live at home doesn't have significant influence to the game-play ($F(1, 12) = 0.151$, $p > 0.05$), however, the analysis shows that having internet at rental place has significantly influence to students playing the game ($F(1, 55) = 8.422$, $p < 0.05$).

According to the analysis results, the demographics do affect students playing the game and hypothesis H_1 is confirmed.

H2: The game-play will affect students' academic achievement of this course

The hypothesis H_2 is discussing the relation between the game-play and the learning performance. We use Pearson product-moment correlation coefficient to test the correlation between the factors in the game-play and the learning performance. All the factors in the game-play are correlated to the mid-term marks ($p < 0.05$), final exam marks ($p < 0.05$) and semester score ($p < 0.01$). However, none of them has correlation to the improvement from the mid-term exam marks to the final exam marks. Table 2 shows the Pearson product-moment correlation between the two categories.

Though the game-play is correlated to the mid-term marks, the final exam marks and semester score, we can't say that the hypothesis H_2 is confirmed because the game-play doesn't correlate with the improvement.

Table 2. The correlation between the game-play and the learning performance.

	Mid-term Marks		Final Exam Marks		Semester Score		Improvement	
	Pearson Corr	Sig	Pearson Corr	Sig	Pearson Corr	Sig	Pearson Corr	Sig
Number of Map Opened	.488**	.000	.378**	.001	.536**	.000	-.228	.051
Number of Problem Taken	.335**	.003	.242*	.038	.342**	.003	-.169	.150
Number of Problem Solved Correctly	.348**	.002	.242*	.038	.354**	.002	-.181	.122
Experience Points	.346**	.003	.245*	.035	.352**	.002	-.177	.131

**. Correlation is significant at 0.01 level (2-tailed)
*. Correlation is significant at 0.05 level (2-tailed)

Discussions

According to the abovementioned experiment analysis, we can find out that:

1. Genders do affect students playing the game. The educational game designers should consider designing gender dependent contents and user interfaces to attract both male and female students (Kafai, 1996).
2. Students have or have no internet access at rental place does affect their game-play behaviours. The possible reason is that they feel free to play the game at their own private place if compared to at home. Having or having no internet at home does not affect students playing the game. One possible reason is that their parents might not like them to play computer games at home. However, only one student has no internet at home in this experiment. We need to test this finding further in our future experiment.
3. There is significant relation between the game-play and the marks/scores. The data shows that the students who solved quests more usually have higher marks/scores. This finding indicates that high academic achievement students have more interests to play the self-assessment game. The finding also tells us that low academic achievement students might be afraid to play the game due to their fear of failure. So when we

develop the quests, we should consider having quests in different difficulty to increase low academic achievement students' confidence of playing the game.

4. There is no significant relation between the game-play and the improvement from mid-term exam to the final exam. One possible reason is also related to academic achievement, i.e., most students who play the game are high academic achievement students, hence, their improvement from the mid-term exam to the final exam is slightly.

5. Conclusion

This research finds out that the factors which influence students playing the self-assessment game. Two hypotheses are examined by using ANOVA and Pearson product-moment correlation coefficient. The first hypothesis shows that different genders affect students playing the game as well as the internet access way they have at home. The second hypothesis points out those students who have better academic achievement (i.e., having higher marks and scores) are willing to use the self-assessment game to practice the knowledge and skills learned from the classroom.

Students who use the self-assessment game are still less relatively. According to the feedback, the game needs to have a more attractive user interface in order to motivate students playing the game. Also, put PvP (Player vs. Player) and PvE (Player vs. Environment) elements can also raising students' interests effectively.

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