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Understanding Health Management Information Systems with a 3D Role-Playing Game for Undergraduate Computer Science Students

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Abstract: In this paper a case study is described in which a 3D role playing game was used to teach undergraduate computer science students about health management information systems (HMIS). Thirty students were asked to complete a pre-test about HMIS in Tanzania. The participants were then asked to play a 3D role playing game for half an hour after which they were required to complete a post-test. It was found that the participants' tests scores improved in the post-test and that these differences were statistically significant at the $p < 0.05$ level. This case study helps to provide some evidence that 3D role playing games can be used to improve student learning.

Introduction

Current generations of school-goers have changed the dynamics in which they learn, learning by more interactive teaching methods than previous students (Vawter, 2009), and as a result, the current trend in higher education shows a move away from "didactic content delivery, the transfer of discrete, abstract, decontextualised concepts" towards models that incorporate a constructionist methodology by placing anincreasing emphasis on supporting "independent, self-motivated learning" (Hobbs, Brown & Gordon, 2006).

The use of active learning techniques has yielded many benefits in the classroom (Bonwell & Eison, 1991; McCarthy & Anderson 2000), including those of high motivation and relevance of subject matter. Vawter (2009) believes that this changing dynamic occurred as a result of the introduction and use of computers at an early age and therefore the use of simulations and games in the classroom have been proposed to be effective in the transfer of knowledge and skills to students (Gremmen & Potters, 1997) and providing mediums for the passage from "knowledge to action and back again" (Crookall & Thorngate, 2009).

While there exist many methods for incorporating active learning techniques into the classroom, Hobbs et al. (2006) maintain that the gaming software industry provides systems and environments that offer a much greater range of interactive possibilities than the current generation of virtual learning environments utilized by most universities such as Moodle or WebCT.

The concept of role playing as a teaching style is not new (McCarthy & Anderson, 2000; Watson, Mong & Harris, 2011) nor is the use of games in the classroom to teach concepts (Gremmen & Potters, 1997; Tüzün,Yılmaz-Soylu, Karakuş, İnal & Kızılkaya, 2009). However, what has been lacking is the study of the application of games within a Caribbean context, as well as actual results of the application of role playing within a game to teach particular course concepts. As a result, research in this area will help to add to the body of knowledge.

The research question addressed in this study is: can a 3D role playing game be used to improve participants' scores on a test about health management information system in Tanzania.

The remainder of this paper is organized as follows. In the next section the context of the study is described followed by the methodology, results and discussion. Finally, the conclusion and future work is presented.

Context

The University of the West Indies, Cave Hill Campus is the smallest of three campuses making up a regional Caribbean university, and offers both undergraduate and post graduate programs in five faculties: Humanities and Education, Law, Social Sciences, Medicine, and Science and Technology. Within the Faculty of Science and Technology the Department of Computer Science, Mathematics and Physics offers three year BSc programs in Computer Science and Information Technology. In both of these programs a compulsory second year course is offered in software engineering. Students may also choose to complete the final year Information

Systems elective. It is within these two courses that this study was conducted.

Methodology

Participants

The participants of this study were drawn from two undergraduate classes, a second year software engineering class and a third year information system class. Thirty students completed the study, twenty-one males and nine females.

The Role Playing Game

A 3D role playing game was created using Unity3D, a gaming engine that incorporates the use of animations, audio, text capabilities and gaming objects for the creation of either 2D or 3D games. Within Unity3D, gaming objects can be controlled and manipulated through scripts created in C# or JavaScript. For the development of this game, C# was used.

The game design was based upon a summarized extract of a case study entitled "Integrated Health Information Systems in Tanzania: Experience and Challenges (Smith et al., 2008)."

The case study examined the issues associated with the failed implementation of a Health Management Information System (HMIS) in Tanzania which was caused by a complicated hierarchical structure of data collection and reporting within the health care facilities, as well as the existence of corruption within the health sector. Additionally, the case study highlighted a series of political, social and cultural issues that also negatively affected the implementation of the HMIS.

Within the case study, information was collated from identified interviewees, and this was translated into the game by the introduction of non-playing characters (NPCs) that assumed certain identified roles from the paper and interacted with the player to provide them with information (from the case study)(See [Table 1]). Each of the NPCs assumed one of the identified roles contained within the paper, except for two of the NPCs which were introduced to provide independently uncorroborated information from anonymous sources. Additionally, interactive objects such as desks containing papers were used to provide information found in reports mentioned within the paper or relevant background information. The information obtained by the player from the NPCs and interactive objects was then used to complete the game.

Instrument

The research instrument used was a 12 question closed-ended MCQ test about the HMIS in Tanzania. Examples of the questions asked are "Which person or agency has responsibility for the Health Management Information System (HMIS)?;" and "What effects can you perceive the promotion and acceptance of bribes by doctors for good service or medicine would have on the HMIS?"

Role / Interactive Object	Description of Information Provided
Senior Member, Ministry of Health	The "on the surface success" of the HMIS; lack of trust in the accuracy of the data contained in the HMIS
Rural Medical Aid	The original duties and responsibilities of the Rural Medical Aids and the effect of the introduction of the Civil Service Reforms
Assistant Clerical Officer	Undermining of authority of Assistant Clerical Officers by Rural Medical Aids
District Medical Officer	The roles of the different persons or agencies in the health sector, along with their responsibilities
District Health Worker	Linking of the District Medical Office and Rural Medical Aid performance assessment with the HMIS output; lack of incentive for accuracy of data recording; complexity of data collection and registers

Village Health Worker	Information pertaining to the first and second iterations of the HMIS, including the issues surrounding the first implementation and subsequent changes made for the second implementation; the complex process of data collection and information flow in the health care facilities
Soldier A	The issue of corruption and acceptance of bribes by doctors
Soldier B	How complaints are handled by patients in the village; the acceptance of bribes, by some of the community leaders, from doctors to maintain monopoly positions and avoid demotion
Desk A	"Report extract" containing information related to the successful district and reasons for why it was successful
Desk B	Capturing of tabulated data identifying problems with the HMIS and proposed solutions, based on the Health Research for Action evaluation and interviews conducted

Table 1: Description of information provided by each role of non-player character or interactive object

Data Collection

Students were invited to attend a two-hour laboratory session and the purpose of the study and its methodology was described by the researchers. Students were then given 15 minutes to complete the 12 question pen and paper pre-test. Students were asked not to guess any of the answers to the questions, rather they were asked to write "I do not know" beside any question that they did not know the answer. Students were then allowed to play the game for half an hour.

On completion of the game, the students were given 15 minutes to complete the post-test (which was the same as the pre-test). The researchers then collated the responses for each student based on their pre- and post- test.

Although, two participants were removed from the study since they played on the same computer and collaborated while playing the game; thirty students participated in the entire study.

Data Analysis

In this study both descriptive and inferential statistics were utilized. Frequencies were used to measure the frequency of correct responses of participants on each of the questions and a paired sample T-test used to determine if there were statistically significant differences between pre- and post- responses at the 95% confidence level.

Limitations

The main limitation of this study was that a control group was not used.

Findings

There was an increase in the number of correct participants' responses for each of the 12 questions in the post-test as illustrated in [Figure 1]. This implies that learning did take place during game play. From the results it appears that about one-third of the participants were able to determine the answer to the first question during the pre-test, however generally speaking students did not know most of the answers (during the pre-test).

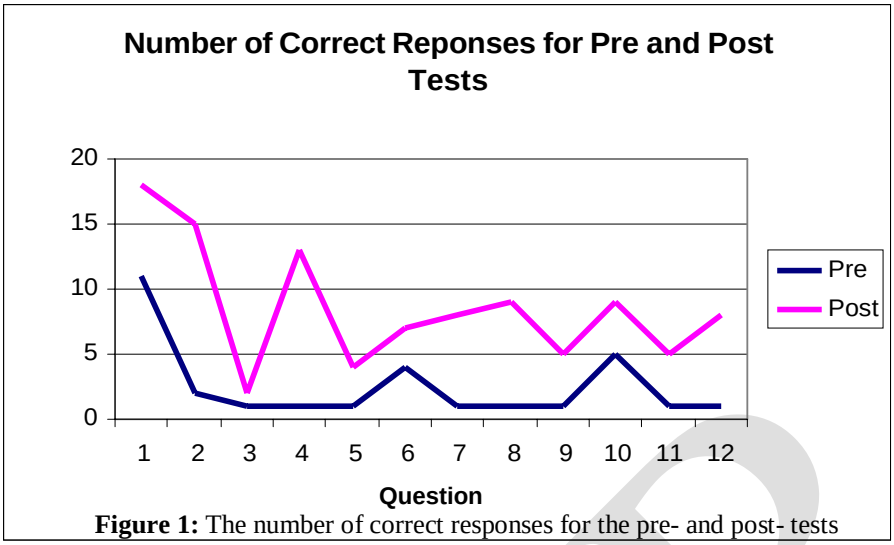

Figure 1: The number of correct responses for the pre- and post- tests

At the beginning of the game participants were excited about the look and feel of the game (see [Figure2]) and found it fun to play. Several of them collaborated in order to find the NPCs and get the required information. Some students also began to take notes of important information.

Although, participants were engaged throughout the game they had a number of comments which are presented in the paragraphs below.

Participants generally felt that the overall purpose of the game was not clear. Although the purpose of the game was described by the researchers at the beginning of the session, the actual game did not prompt the player as to the overall objective of the game. Neither did it help the player to determine what the player's next move should be during game play.

Participants also believed that there was too much text to read and that voice-overs could have been used to complement the text. Because there was so much text participants felt that they were cramming for a test.

Several of the participants felt that there should have been more interactivity and than the music although interesting at first became monotonous. One participant felt that a map would have been useful to navigate the rooms in the building however another participant stated that he did not feel that the building was large enough to warrant a map.

Figure 2: Pictures of the participants during game play

The results of the paired samples T-Test showed statistically significant differences in seven of the 12 questions (see [Table 2]).

		t	df	Sig. (2-tailed)
Pair 1	PreQ1 - PostQ1	-2.249	29	.032
Pair 2	PreQ2 - PostQ2	-4.709	29	.000

Pair 3	PreQ3 - PostQ3	-.571	29	.573
Pair 4	PreQ4 - PostQ4	-3.890	29	.001
Pair 5	PreQ5 - PostQ5	-1.361	29	.184
Pair 6	PreQ6 - PostQ6	-.902	29	.375
Pair 7	PreQ7 - PostQ7	-2.536	29	.017
Pair 8	PreQ8 - PostQ8	-2.804	29	.009
Pair 9	PreQ9 - PostQ9	-1.682	29	.103
Pair 10	PreQ10 - PostQ10	-1.682	29	.103
Pair 11	PreQ11 - PostQ11	-2.112	29	.043
Pair 12	PreQ12 - PostQ12	-2.536	29	.017

Table 2: Results of the paired-sample T-Test for pre- and post- scores

Conclusions

In this paper a 3D role playing game was successfully used to improve the test scores of computer science undergraduate students in a HMIS test. Students were required to take a pre-test, play a role playing game and then complete a post-test. It was found that the number of correct responses for each of the 12 questions increased in the post-tests with statistically significant differences being found for seven out of the twelve pre-/post- pairs.
Some of the feedback received on the game included 1) the objective of the game was not clear 2) students felt that there was too much text to read and it was like reading from a textbook 3) students wanted more interactivity and voice-overs to reduce the amount of reading required. Of note was the fact that none of the participants complained about not liking the game genre and that the game activity seemed to foster
participant engagement and collaboration.
Although this study cannot be generalized it provides us with new insights into how 3D role playinggames can be used to foster learning.

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