A 3D Game-Based Learning System for Land Administration Subjects

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SUMMARY

The students' feedback on the Land Administration Systems subjects often includes a desire for experiencing social, environmental, and economic issues related to land in a less theoretical manner. In response to this feedback, a game based 3D Virtual Environment called, Saving Earth, Populating Mars, has been developed for the Land Administration Systems subject at the University of Melbourne. In this 3D VE game, students gain knowledge to collect information about a country and analyse the information for designing and developing policy, workflow, databases, and information systems for land administration in that country.

This paper presents learning affordances of this 3D virtual environment (3D VE). The paper evaluates if and how the virtual environment enhances the learning experience of students. It has tested if a dynamic, close to reality, visually compelling and exciting experience enhances educational outcomes of the land administration subject. The results demonstrate a positive attitude to the integration of a 3D VE in students' learning in the land administration subject. It is noted that there are certain qualifications to the environment's effectiveness in the learning process, with the greatest being the game's level of development.

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1. INTRODUCTION

Computer games are most often thought of as pure entertainment; it is important to understand that they are enormously powerful learning tools. In a recent paper, (Oti, 2012) remarks: "The students are playing a mission in the World of Warcraft (WoW): an online role-playing game. The mission presents the students with a series of problems that must be solved. Every student controls an avatar that possesses a unique combination of competencies. Successful completion of the mission requires collaboration between avatars. In the real world, this entails development of higher order cognitive skills. The students will need to use analysis, synthesis and evaluation to solve the problems. In recognition of their efforts, the WoW rewards the students by increasing the proficiencies of their avatars. Is it not possible for higher education to give the students a much greater reward for their efforts? Are students missing out on the chance of developing higher order cognitive skills through digital games? Can digital games be used to enhance collaborative learning activities?"

There are two key reasons as why we need consciously to use computers and video games for learning. First is that the learners in universities have grown up with digital technologies of which computer and video games are a major part. It has changed the way the learners think and process information. Second, is that the learners need to be motivated in new ways. One of the problems facing today's formal learning classroom and online distance learning systems is to keeping students motivated. The old methods of motivation in education are not effective today (Prensky 2005).

Studies show that students from kindergarten up until they are 21 years old spend fewer than 5000 hours of their lives reading, 10000 hours playing video games, 20000 hours on video games, 20000 hours on TV and 10000 hours on mobile. This is almost 30 percent of 16 years of a learner's life on digital media (Prensky 2001). As a result of this, today's students have become a different type of learners. They are able to process information quicker. They can process various streams of information in parallel. They have become non-linear thinker where their minds can change focus very quickly. They are visual and graphical learners. The students are less constraint with location and are connected to the rest of the worlds. They rarely use manuals and have become experimental and active learners. Computer games have led them to combine fantasy and reality. Most importantly, they expect prompt rewards (Prensky 2005).

These all suggest today's learners cannot be motivated and engaged based on reward and punishment which ensure the desired learning outcomes are achieved in today's university education systems (Gee 2003). Game playing is, of course, just the opposite. The main reason we play games because it is engaging, and the video games are most engaging pastime. They are fun

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and game. They encompass goals and rules. They are interactive and adaptive. They develop problem solving state of mind and possess win-states.

This paper investigates learning affordances of 3D virtual environments (3D VE), focusing on the existing 3D VE, developed in the University of Melbourne. To evaluate if and how virtual environments enhance the learning experience of students, the paper tests if a dynamic, close to reality, visually compelling and exciting experience enhances educational outcomes of subjects.

2. SAVE THE EARTH, ORGANISE MARS

Imagine a crisis on Earth; the world's population is growing fast. There is not enough arable land for agricultural purposes and production of food. At the same time the world is struggling to find enough land to build shelters and houses for people to live. People are fighting over land. Land is scarce and land grabbing is increasing fast. Courts are full of people that want to resolve ownership and boundary disputes. People are illegally constructing shelters and houses. Slums are growing everywhere without governments can do anything about them. This crisis can eventually result in a worldwide war over land.

Governments around the world are struggling to find an effective way to accommodate people and produce food. At the UN a decision has been taken to set up territories in Mars to relocate some of the population to Mars. The UN wants each territory in Mars to set up and effective land administration system, so the land can be efficiently distributed and people relocating to Mars can securely buy/sell , develop and invest in land.

The mission of you is to take over responsibility of a territory as its governor. For each territory, responsible organisations should be established, policies should be developed, land information should be collected and an information infrastructure such as databases and communication networks should be developed. The name of the game is Save the Earth, Organise Mars (Figure 1).

Figure 1: A screenshot of the game user interface

Save the Earth, Organise Mars is game based learning for undergraduate students undertaking, first, second and third year in BEnv, BSci and postgraduate students doing the Master of Engineering (Spatial) course. Save the Earth, Organise Mars provides a virtual environment, in which each student works as a governor to create land administration system. Activities involve territorial land analysis, designing land policy, designing land information databases, investment in property. The game aims to teach the application of land administration, ownership and investment theories within a real world context.

The outputs of each student are measured against the requirements of territory. Students are asked to prepare a presentation to the UN on their land administration system and its characteristics, which will take place at each millstone (three presentations each worth 10%). At the end of the semester student should also provide a written report (worth 20%). As part of the final report, students will be asked to reflect on their experiences playing the game. The student will be also assessed in a written exam (worth 50%) at the end of the semester.

3. METHODOLOGY

A series of learning affordances for 3D VEs (Figure 2) was investigated by introducing the game based learning system. These learning affordances were validated and evaluated, with the possibility of identifying further affordances. A questionnaire was used to evaluate the learning affordances of the game consists of three areas of feedback. First, students are required to respond to positive and negative statements related to their interaction with the game and its application in learning Land Administration Systems. Second, students are required to provide details as go their history with 3D VEs and compare the game to their existing learning with qualitative feedback.

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Figure 2: 3D virtual environment of the game

Finally, experienced gamers are asked to provide detailed feedback on game improvement. The respondents for this study were the current 78 students enrolled in the Land Administration System Subject.

4. RESULTS

4.1 Quantitative analysis

Students were asked to respond to several questions about the game as outlined in Table 1.

84% of students agree that the game offered a different way of learning and 45% of students responded that their learning would be better with 3D Virtual software incorporated into their subjects.

The majority of the high disagree percentages in the survey results are in response to negative statements, such as 64% of respondents disagreeing that the game is a waste of time. The rest of the high disagree percentages are related to game functionality. These results were expected as the game is in the alpha development stage. As development proceeds and the game improves, these values are expected to decline.

STATEMENT	No RESP.	1	2	3	4	5	TOTAL RESP.
I was engaged in the learning experience in Saving Earth, Populating Mars	1	2	12	26	30	7	**77**
Saving Earth, Populating Mars is a helpful	3	1	8	34	27	5	**75**

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program for my learning							
I enjoyed the 3D virtual environment as an information delivery system	1	0	9	20	35	13	**77**
In the future, I would prefer to learn with 3D Virtual Reality software than with textbooks	1	4	9	17	24	23	**77**
In the future, I would prefer to learn with textbooks than with Saving Earth, Populating Mars	2	9	22	25	14	6	**76**
Learning would be easier with Saving Earth, Populating Mars	0	0	11	36	23	8	**78**
I was willing to explore the program	1	0	7	11	33	26	**77**
I liked using Saving Earth, Populating Mars as an additional learning tool	1	2	5	23	21	26	**77**
The visual representation of data in Saving Earth, Populating Mars is better for my understanding	1	1	13	28	25	10	**77**
The 3D spatial distribution of the game play keeps me entertained between information bursts	1	3	10	22	26	16	**77**
Saving Earth, Populating Mars is a waste of time	2	13	36	20	5	2	**76**
I would recommend that Saving Earth, Populating Mars be used in next year's course	1	1	22	22	19	13	**77**
The game offered a better way of learning	1	2	8	33	25	9	**77**
Saving Earth, Populating Mars is well organised	3	1	16	36	18	4	**75**
It was difficult to understand Saving Earth, Populating Mars	1	4	24	25	20	4	**77**
I could not navigate my way through Saving Earth, Populating Mars	0	10	15	26	20	7	**78**
I would avoid a class using 3D Virtual Reality software in the future	0	21	28	24	4	1	**78**
Saving Earth, Populating Mars allowed me to better understand subject material	0	0	10	31	27	10	**78**
Saving Earth, Populating Mars helped me focus on understanding the information rather than finding it	2	1	15	31	22	7	**76**
The game introduction and instructions on using Saving Earth, Populating Mars were clear	1	2	13	31	25	6	**77**
The game offered a different way of learning	1	0	3	9	37	28	**77**
Playing Saving Earth, Populating Mars was a useful experience	3	0	4	36	29	6	**75**
I would learn better with 3D Virtual software incorporated into my subjects	0	2	7	34	23	12	**78**

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Table 1: Survey questions and results

The results show that students with high gaming experience responded positively to the game, above the core analysis percentages. 14 of the 23 questionnaire statements were significantly increased. 89% of experienced gamers' rated themselves willing to explore the program with only 5% stating they were unwilling.

There were 58 male respondents and 19 female respondents. A comparison of percentages with the core analysis as well as between the female and male statistics is possible.

Overall by the numbers alone, males tended to respond positively to the game in comparison to the females. The responses to the question How was Saving Earth, Populating Mars different/better than Course or LMS online tools? were positive. Females responded that the game was "more visually interesting", "provided a different way of learning that was more engaging than conventional tools", and "interacts with the audience, missions and achievements. So it's quite interactive".

4.2 Qualitative analysis

The questionnaire contained several questions providing the respondent with an opportunity to respond with comments. The questions focussed on comparing Saving Earth, Populating Mars to existing systems, evaluating the positives and negatives of the game, and additional development ideas to enhance the game. The questions are as follows:

4.2.1 How was Saving Earth, Populating Mars different/better than Course or LMS online tools?

This question was included in the questionnaire to provide a comparison between traditional course information delivery and 3D VE. The majority of students responded positively that Saving Earth, Populating Mars was better than current course online tools.

4.2.2 What is the one thing you would change about Saving Earth, Populating Mars?

This question was included in the questionnaire to determine the change of utmost importance to student engagement. This change would be the foundation for future development.

The result of this question is that development should be focussed on the game engine's ability to render the 3D environment and movement within the game.

4.2.3 What is one thing you liked about using Saving Earth, Populating Mars?

This question was included in the questionnaire to determine existing features of importance to the students. These will need to be considered in future development as points to be developed. The result of this question is that development should focus on keeping the 3D environment and information delivery via trivia.

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4.2.4 What would need to be included to make the 3D Virtual Environments more engaging for your learning?

This question was included in the questionnaire to determine features to address the learning component of the game. This question provides multiple development avenues to enhance the learning opportunities within the game. Clearly from the responses, students require a challenging environment to immerse themselves in the learning process. The recommendations focus on game interactions to deliver information in a manner they are accustomed to, from games such as Sim City, Age of Empires, and Civilization. For these enhancements to be implemented successfully, research on existing gaming systems will be needed.

4.2.5 Which part of the 3D Virtual Reality in particular do you think will improve your learning?

This question was included in the questionnaire to build on the previous question and examine the effect of the third dimension on students' learning. The answers to this question reiterates the visual nature of students and its application in the learning process. Given the recurring visual theme throughout the five questions, development should focus on a visually immersive environment to support information understanding and retention.

5. CONCLUSIONS

This paper evaluated the learning affordances of a 3D VE in higher education with a particular case study in the Land Administration Systems subject. The feedback from the case study's questionnaire demonstrates a positive attitude to the integration of a 3D VE in students' learning. It is noted that there are certain qualifications to the environment's effectiveness in the learning process, with the greatest being the game's stage of development. From the quantitative and qualitative feedback of this case study, it is evident that even a rudimentary alpha-stage 3D Virtual Learning Environment has positive learning affordances in higher education. The study identified the need for student learning to include virtual reality as a means of engagement and the need for rapid feedback to reward the student's learning.

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BIOGRAPHICAL NOTES

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