Peer-reviewed paper

Evaluating Unity created teaching simulations within occupational therapy

Greg Sutton, Karen Newberry and Kate Threapleton

Greg Sutton is a Learning Technology Developer at the University of Derby, Derby, UK. Karen Newberry is a Senior Lecturer at the Department of Occupational Therapy, University of Derby, Derby, UK. Kate Threapleton is a Research Fellow at the School of Health Sciences, University of Nottingham, Nottingham, UK.

Abstract

Purpose – *The purpose of this paper is to describe the evaluation of an educational occupational therapy home visit simulation newly built in Unity, compared with a previously created simulation based in the Open Sim platform. The evaluation is based on students' preferences.*

Design/methodology/approach – *A simulation was built in Unity in which the academic content was identical to the previous Open Sim-based simulation. Student groups used the simulations then completed a questionnaire. Numerical data and descriptive comments were analysed.*

Findings – *Students preferred the simulation built in Unity to the Open Sim simulation. Improvements with the Unity simulation include; reduced time to gain competence to use, ease of use and fewer negative physiological experiences. The small percentage of students experiencing motion sickness is an ongoing concern and warrants further investigation. The Unity simulation may also be useful as an academic assessment tool.*

Research limitations/implications – *Findings are limited by short time usage of the simulations in 3D virtual worlds with confined spaces and no requirement for in-world group interaction, and by some methodological limitations including the research being based within a single higher education institution, and with a profession-specific group of students.*

Originality/value – *This paper highlights student preference for using a purpose built simulation created with Unity over a simulation built in Open Sim, showing where best to spend future development time and funding. Similar comparison research is scarce.*

Keywords *Stroke, Second Life, Higher education, Occupational therapy, Academic assessment, Unity*

Paper type *Research paper*

1. Introduction

The higher education institution (HEI) in this study has been using Second Life (2015) and Open Sim (2015) within teaching for some time and had previously assessed their educational value (Sutton, 2011). Lecturers from the pre-registration occupational therapy programmes became aware of the Second Life projects and felt there was potential to apply it within their taught modules. However Second Life has a complicated user interface and takes some time to learn, it also limits land space and the number of objects that can be created. As all the users occupy the same virtual world it limits the number of students that can simultaneously use the simulation. This was ascertained through the research described in Rowe and Newberry (2012). It was felt that to improve the student experience an alternative should be sought in which each student has their own virtual world and the interface is simpler to learn how to use. This study evaluates the implementation of that alternative and its' continued development.

1.1 Background

Received 27 November 2015
Revised 24 February 2016
Accepted 26 February 2016

A key role of an occupational therapist is to conduct pre-discharge home assessment visits to determine the level of support a patient may require on discharge home from hospital.

This involves looking at the cognitive, sensory, perceptual and physical capabilities of the patient, and the home environment to which he or she will be returning. Previously students were taught how to perform a home assessment prior to their first placement by means of a paper-based exercise in the classroom; students were shown a floor plan of the home, given paper-based information and asked to consider potential issues. Research by Rowe and Newberry (2012) identified using the virtual world simulation developed in Second Life within the classroom setting, instead of the paper-based resources, increased students depth of understanding and student confidence. Students' only concerns were with the ease of use of the interface. Students were given the scenario of a patient with a stroke who was about to return home, and asked to assess the virtual home. They did this by navigating around the virtual home and clicking on potentially hazardous objects (such as an uneven rug or low-level switch on a fire), to get additional information. Students then provided their professional reasoning as to why the objects would be potentially hazardous for the person in the scenario.

1.2 Move from Second Life to Open Sim

As with the real world home visit simulation developed in nursing (Richards *et al.*, 2010), it was obvious that one virtual home would not be suitable for 20 or more students to assess simultaneously, due to overcrowding of the virtual space. This issue was initially resolved by duplicating the home. To further reduce the number of avatars in each home, the students were asked to work in groups of two or three around one PC. After running these classroom sessions for one year, and having no room to expand for more simultaneous users in Second Life, it was decided to move the exercise to Open Sim. Open Sim is a free un-hosted version of the Second Life platform. The home was copied from Second Life into Open Sim and four homes were created.

1.3 Move from Open Sim to Unity

The occupational therapy lecturers required an increased number of students to access the simulation simultaneously. This along with the time it take gaining competence to use the Open Sim interface, due to there being many features that are not required, the significant negative comments about it previously reported (Rowe and Newberry, 2012), and potential exploration of the simulation in a clinical setting, all led to the realisation that the Second Life and Open Sim platforms may not be the ideal platforms for the future. After scoping of platforms available it was decided to trial a redevelopment of the virtual home using the Unity game engine (Unity, 2015). Unity was chosen because it has a free licence and can publish to the web, PC, Mac and most mobile devices. It also is relatively simple to use, it gives complete control over the interface developed and there are no additional maintenance costs once development is complete.

Data collection occurred in two stages. Findings from the first stage of the research indicated the Unity simulation was preferable; hence this was implemented through further development of the simulation. This lead to a second stage of data collection to focus on students ongoing perceptions of the Unity simulation.

2. Aim

In light of the proposed exploration of using Unity, this action research aimed to answer the primary question: is the bespoke simulation built in Unity preferred by students over the use of Open Sim when comparing the time taken gain competence to use and ease of use? Secondary aims were: to canvas student opinion around the use of the Unity-based scenario as a potential academic assessment tool, and to monitor negative physiological impacts of using virtual learning simulations.

3. Methodology

3.1 Product development

In order to make a direct comparison between the interfaces of the Open Sim and the Unity simulations it was decided to take the Open Sim build and make the academic content of the

Unity build as close to it as possible, as the pedagogic value of the Open Sim exercise had already been established (Rowe and Newberry, 2013). Measurements for each room were taken from Open Sim and the rooms were faithfully recreated (Figure 1).

3.2 Data collection

3.2.1 Stage 1. Data were collected within sessions delivered as part of the students' normal taught programme located in standard university computer labs. To compare the established Open Sim simulation with the new Unity simulation, students were asked to use the two simulations, and complete a questionnaire based on their experiences, including any physiological issues that arose for them. The questionnaire contained closed questions (Table I), and opportunity to provide qualitative written comments. For ethical reasons students could opt out of completing the questionnaire if they wished, and to maintain anonymity autobiographical data were not considered.

The convenience sample of 78 first year pre-registration occupational therapy students were split into four groups. Groups 1-3 were BSc (Hons) occupational therapy students, Group 4 were MSc pre-registration occupational therapy students. Groups 1-3 logged into the Open Sim simulation and the Unity simulation (Figure 2) and were given one of two case scenarios. The scenarios devised by the occupational therapy lecturers aimed to be comparative in complexity and were both based on neurological conditions which would result in similar clinical features. This was important not only for students learning, but also to ensure that difference of clinical condition in the scenarios did not introduce a bias into students perception of Unity or Open Sim simulations.

As with the original Second Life simulation in both the Unity and Open Sim simulations students navigated around the virtual home clicking on objects they thought may be an issue for the patient. When clicking on an object, students were presented with a question, visible in Figure 2. The question both provided more information about the object that may not be obvious by looking at it, e.g. weight or height, and asked, "What type of concern is this?". Six possible concerns were provided to choose from, e.g. motor, perceptual, sensory and a text box was provided for completion of professional reasoning to support the choice of type of concern selected. When students had finished the exercise they were presented with the answers they had entered. Lecturers facilitated student discussion on their professional reasoning and students then returned to the virtual home to see sample answers for each question to reinforce their learning.

Group 1 ($n = 18$) were trained to use the Unity simulation in a 15-minute session. The session covered navigation, zooming in on objects and interacting with objects. These students were given Scenario 1 of a patient who had experienced a stroke, and individually undertook the simulation exercise in Unity. They were then put into sub-groups of two or three and trained to use Open Sim for 30 minutes; it was felt more time is required to achieve competence in using Open Sim. Students had to work in these small sub-groups, as there were only four instances of

Figure 1 Living room in Open Sim and Unity

Table I Quantitative questionnaire results

Question		Group 1 n = 18	Group 2 n = 21	Group 3 n = 18	Group 4 n = 21	Group 5 n = 50	Groups 1 + 2 + 3 n = 57	Groups 4 + 5 n = 71	Totals n = 128
1 How quickly do you think you became competent enough in Open Sim to carry out the activities asked of you?	Immediately	2	7	1			10		10
	Quickly	14	12	16			42		42
	Slowly	2	2	1			5		5
	Not at all	0	0	0			0		0
2 How quickly do you think you became competent enough in Unity to carry out the activities asked of you?	Immediately	7	8	6	1	17	21	18	39
	Quickly	9	9	12	15	29	30	44	74
	Slowly	2	3	0	5	4	5	9	14
	Not at all	0	0	0	0	0	0	0	0
3 Which did you find easier to learn how to use Open Sim or Unity?	Open Sim	4	3	2			9		9
	The same	2	5	7			14		14
	Unity	12	12	9			33		33
4 Which did you find easier to use Open Sim or Unity?	Open Sim	3	3	1			7		7
	The same	3	4	5			12		12
	Unity	12	12	12			36		36
5 Did you experience motion sickness, nausea or dizziness while using either of the interactions?	Open Sim	3	0	2			5		5
	Both	1	0	2			3		3
	Unity	0	1	0	2	9	1	11	12
	No	13	20	13	19	40	46	59	105
	Nil response	1	0	0	0	1	1	1	2
6 Would you like to use Unity as part of a module summative assessment?	Yes					21		21	21
	No					21		21	21
	Nil response					8		8	8

Figure 2 Questions

the home available to use in Open Sim. Students were then given Scenario 2 of a patient who had experienced a head injury and this time in the sub-group they were asked to carry out the simulation in Open Sim.

This process was repeated in the same manner with Group 2 ($n = 21$) and Group 3 ($n = 18$), however Group 2 did the exercises in the opposite order to determine whether the order in which students used the simulation biased the results. Group 3 ($n = 18$) worked in sub-groups for both exercises, again this was an attempt to eliminate the possibility that students working in small sub-groups, or working individually, could bias the results. Due to the limited number of homes in the virtual world it was not possible for individuals from any of the groups to access Open Sim on a one home per student basis, which methodologically would have been the ideal in terms of limiting bias. Group 4 ($n = 21$) only used the Unity platform, as their taught programme schedule meant they used the simulation in their own time with only printed instructions and no training.

The questionnaire Group 4 completed was amended to reflect that they did not have opportunity to access Open Sim.

The quantitative results of the questionnaires were analysed using simple statistics. The qualitative comments were read and key themes identified using a deductive approach to thematic analysis. The number of students making comments directly related to these themes was then tallied in a spreadsheet, and the percentage of students in that group (Groups 1-4) was calculated for ease of comparison. This analysis was undertaken by the primary author; however, subjectivity could have been reduced by the involvement of the other authors, or external personnel, in these processes.

3.2.2 Stage 2. In light of the findings of Stage 1, and alongside research into the potential use of the simulation in clinical practice, the Unity-based simulation was further developed for use the following academic year. Options were included to allow students to add assistive equipment (such as perching stools, toilet frame and grab rails), to remove hazards (such as rugs) and to make alterations to the building (such as bathroom layout and stair hand rails).

An additional clinical scenario was developed by the occupational therapy lecturers that focused on visiting the home of a patient with mental health problems. Using the original home layout from Stage 1, different types of hazards and concerns commonly associated with mental health were developed within a new simulation, including mental health-specific questions and answers. Work was also undertaken to ensure student answers were securely stored in the database, which gave rise to the possibility in the future of the simulation becoming an online academic assessment.

A new group of first year BSc (Hons) occupational therapy students, Group 5 ($n = 50$), were trained to use Unity. They undertook the newly developed mental health scenario, discussed their professional reasoning and viewed the sample answers. The following week they undertook the same stroke scenario as in Stage 1, again discussing their professional reasoning and viewing the sample answers. These students then used the simulation developed with options for addition of adaptive equipment and making environmental changes to accommodate the needs of the patient in the stroke scenario. As in Stage 1 of the study, students were asked to complete a questionnaire which followed a similar format, with relevant questions from the first questionnaire remaining and questions pertaining to the potential use of the simulation as a summative assessment being added. Data analysis of the Group 5 results was completed as in Stage 1 of the study.

4. Results

4.1 Quantitative results

All students in the five groups participated in completion of the questionnaires. Numeric data were summed for each group (Table I) and percentages were calculated (expounded upon in Section 4.3). As well as summing for each group it was also summed for Groups 1 + 2 + 3 (Open Sim and Unity), Groups 4 + 5 (Unity only) and the totals for all five groups were also calculated.

4.2 Qualitative results

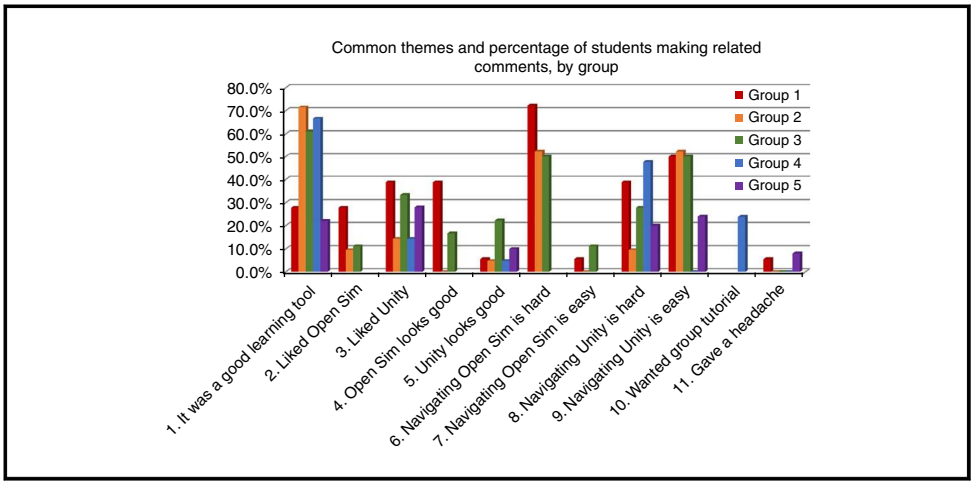
From the qualitative comments, 11 themes emerged. These are displayed in Figure 3, which illustrates the percentage of students in each group that made a comment relating to that theme.

Detailed results and more detailed analysis of the results for Stage 1 can be found in Sutton (2014).

4.3 Discussion and analysis

4.3.1 Continued use of interactions. One significant theme to emerge from the qualitative comments was that students view such technologies as a good learning tool (Figure 3, Theme 1). This supported the findings of Rowe and Newberry (2013).

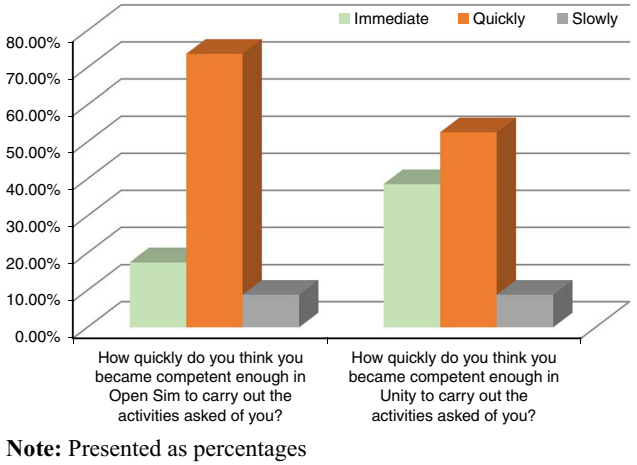
Figure 3 Common themes and percentage of students in each group making comments related to each theme



4.3.2 Open Sim or Unity. Overall students in this study would appear to prefer the Unity simulation, over and above the Open Sim simulation. No clear patterns emerged within either the quantitative or the qualitative data for Groups 1-3, which indicated that the order the simulations were used in did not impacted on the results. Although a limitation of the study is that no students were able to undertake the Open Sim simulation individually, there was no clear differentiation in data obtained between groups that undertook the Unity simulation either individually or in small sub-groups. A larger scale study, with a more robust methodology would increase the reliability of these results and facilitate more complex statistical analysis. Kirriemuir (2010) notes that Open Sim is being used within a limited number of UK HEI's, however evidence to support students' experiences of Unity as a comparison, or the use of Unity in healthcare education is scant. Furthermore whilst this identifies student preference for use of Unity over Open Sim, further research is required to determine whether adhering to such student preference actually improves student attainment in reaction to learning outcomes.

In relation to speed of gaining competence to use (Questions 1 and 2 in Table I and Figure 4) for both Open Sim and the Unity simulation, 9 per cent of students from Groups 1-3 found it slow

Figure 4 How quickly do you think you became competent enough?



Note: Presented as percentages

to learn how to use the simulations, however when looking at the results for how many students could use it immediately, 38.6 per cent of students said they could use the Unity simulation immediately compared to only 17.5 per cent with Open Sim. This may illustrate that a small proportion of students would find the use of any such technology slow to learn, but that for a significant number of others the Unity simulation was quicker to become competent in using than Open Sim.

Qualitative comments (Figure 3) support these quantitative findings as approximately twice as many students made comments referring to finding it hard to navigate in Open Sim (Theme 6), compared to the number of similar comments made relating to it being hard to navigate in the Unity simulation (Theme 8). Very few students made comments stating it was easy to navigate in Open Sim (Theme 7), whereas a considerable number made comments pertaining to it being easy to navigate in the Unity simulation (Theme 9). Navigation is a key skill to mastery of competence in use of all such simulations.

Questions 3 and 4 (Table I) shows a significant number of students from Groups 1-3, when directly asked, found the Unity interface to be easier to learn how to use and easier to use throughout the exercise, than Open Sim as is highlighted in Figure 5.

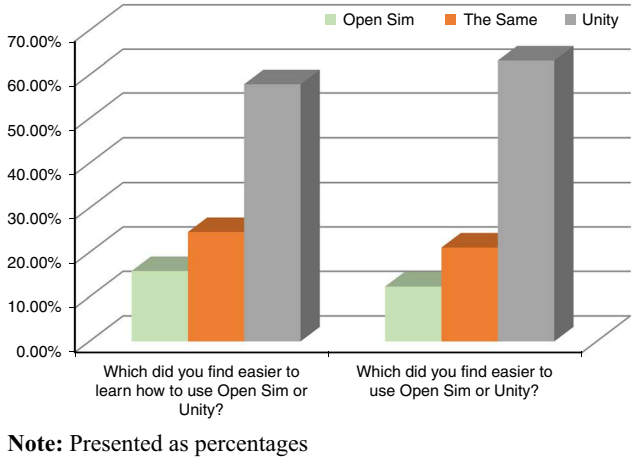
The qualitative comments (Figure 3, Themes 2 and 3) support the quantitative data, as more students made reference to liking the Unity simulation than those commenting they liked Open Sim.

4.3.3 Unsupported use of the Unity simulation. Interestingly when considering the results for Question 2 (Table I) for Group 4 (the only group to use the Unity simulation outside the classroom with only written instructions), there is a much higher percentage of students identifying the Unity simulation as slow to learn, than those who had the tutorial in Groups 1-3. This suggests the 15 minutes tuition given in how to use the Unity simulation is highly valued by the students. This is reinforced by students' qualitative comments (Figure 3, Theme 10), with 23 per cent of Group 4 students stating they would like a tutorial.

4.3.4 Move away from Open Sim and Stage 2 data collection. The above findings informed the decision to further develop the simulation in Unity rather than in Open Sim. Student feedback clearly showed a preference for the Unity simulation and taking into account a number of negative comments about having to learn how to use two similar platforms, it was felt unethical to continue the research in comparing the two.

4.3.5 The Unity simulation as an assessment tool. As outlined previously, the Unity simulation uses a secure database for storing student answers, and does not have the technological limitations of Open Sim, requiring students to work in sub-groups. This opens a possibility for

Figure 5 Which did you find easier?



Note: Presented as percentages

students to undertake academic assessments based on the Unity simulation; such use of virtual worlds assessments has been documented as an area for further exploration (Steils *et al.*, 2015). Table I, Question 6 illustrates student response to this concept; interestingly students were equally divided. Of the eight students that did not provide a yes or no answer; their written comments suggest half were in favour and half against. Many good reasons were put forward for its use; however those against raised valid points that the technology was difficult for some students to use, and that motion sickness during use was a potential issue. While this does not preclude virtual world academic assessments from being further considered, for parity alternatives may also need to be provided for students who experience this motion sickness.

4.3.6 Motion sickness. Throughout the research, data were collected regarding negative physiological impacts of the interactions. As illustrated in Table I, Question 5, for the majority of students this did not appear to be an issue, however for a small proportion this was a concern in both the Open Sim and the Unity simulations, and was commented on in the qualitative comments (Figure 3).

It was anticipated the Unity simulation, being a first person simulation would be a more significant cause of nausea and dizziness than Open Sim which, for this exercise, was a third person simulation (Medina *et al.*, 2008). However within a small home environment, with narrow spaces and little requirement for movement, where a direct comparison can be made with Groups 1-3, the results show the opposite. Eight out of 57 students found Open Sim caused nausea or dizziness, compared to only four out of 57 with the Unity simulation. A possible explanation from the qualitative comments was that the constant movement of the camera relative to the avatar, which only happens in Open Sim, gave some students a headache (Figure 3, Theme 11, Group 1). This suggests the constant movement of the camera is a bigger problem than the motion sickness experienced in first person simulations, therefore indicating a first person controller should be used in this situation.

It is also notable that in response to question 5 (Table I) Groups 4 and 5 who did not use Open Sim, reported more issues of motion sickness with the Unity simulation than Groups 1-3. This may be due to the uncontrolled variable of lighting conditions as subjectively Group 5 did the exercise in a darker room, or the length of time, as Group 5 did four exercises compared to just two with Groups 1-3. It is not known what conditions Group 4 undertook the interactions in, as they did this independently, but they also only undertook one exercise. More rigorous research, with greater control of variables would be beneficial, as although motion sickness only affected a small number of students, ethically it is an important area for further investigation.

5. Conclusion

To answer the question “Is the bespoke simulation built in Unity preferred by students over the use of Open Sim when comparing the time taken to gain competence to use and ease of use?” Stage 1 of the research indicated a student preference for the use of the purpose built simulation in Unity. Students found the Unity simulation quicker and easier to learn how to use than Open Sim and easier to use once learnt. A short face to face tutorial on how to use the Unity simulation also appears valuable to students. Throughout the research this type of learning tool was valued by students, but a small number also experienced motion sickness, and this, in addition to use of the Unity simulation as an academic assessment, warrants further investigation as students were divided on this.

6. Recommendations

A number of areas for further research are recommended; first around issues of motion sickness, including the effects of lighting and length of time using the simulation without a break. Research is currently being undertaken into the clinical use of the Unity simulation (Threapleton *et al.*, 2015); data will be collected from practising occupational therapists and patients who have experienced a stroke. In preparation for patient trials steps have been taken to attempt to reduce the risk of nausea by adding a quick navigation map to reduce the need to walk between rooms, the value

of this function in the educational setting would be valuable to include in future educational research. If the issues of motion sickness can be reduced, further research into the use of the simulation as an academic assessment would be beneficial. This study may provide other health-related programmes with insight into student preferences of a bespoke interface over the Open Sim or Second Life interface. Although further research is required to determine whether such preferences impacts on student attainment, this research may provide a useful indicator to guide further development time and funding.

References

Kirriemuir, J. (2010), "Virtual world activity in UK universities and colleges. Virtual teaching in uncertain times", Snapshot No. 8, Virtual World Watch, February, available at: www.silversprite.com/ss/wp-content/uploads/2014/10/snapshot-eight.pdf (accessed 24 November 2015).

Medina, E., Fruland, R. and Weghorst, S. (2008), "Virtusphere: walking in a human size VR 'hamster ball'", *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, Vol. 52 No. 27, pp. 2102-6.

Open Sim (2015), "OpenSim", available at: http://opensimulator.org/wiki/Main_Page (accessed 20 July 2015).

Richards, E., Simpson, V., Aaltonen, P., Krebs, L. and Davis, L. (2010), "Public health nursing student home visit preparation: the role of simulation in increasing confidence", *Home Healthcare Nurse*, Vol. 28 No. 10, pp. 631-8.

Rowe, P. and Newberry, K. (2012), "Second Life virtual learning environment to develop pre-registration students' clinical skills", poster presented at BMJ International Forum on Health and Safety in Health Care, Paris, 17-20 April.

Rowe, P. and Newberry, K. (2013), "An evaluation of a virtual world learning environment home visit simulation in preregistration occupational therapy education", paper presented at COHEHRE Conference on Education for Citizenship and Participation in Health and Social Care, Savonia, 16-19 April.

Second Life (2015), "Second Life official site – virtual worlds, avatars, free 3D chat", available at: http://secondlife.com/ (accessed 20 July 2015).

Steils, N., Tombs, G., Mawer, M., Savin-Baden, M. and Wimpenny, K. (2015), "Implementing the liquid curriculum: the impact of virtual world learning on higher education", *Technology, Pedagogy and Education*, Vol. 24 No. 2, pp. 155-70.

Sutton, G.P. (2011), "Second Life virtual hazard detection", in Peachey, A. (Ed.), *Conference Proceedings: Researching Learning in Immersive Virtual Environments*, Open University, Milton Keynes, pp. 164-74, available at: www.open.ac.uk/about/documents/relive11-conference-proceedings.pdf

Sutton, G.P. (2014), "Occupational therapy home visit interaction", MSc thesis, University of Derby, Derby.

Threapleton, K., Newberry, K. and Rowe, P. (2015), "The application of virtual reality", *Occupational Therapy News*, Vol. 23 No. 8, pp. 28-9.

Unity (2015), "Unity – game engine", available at: https://unity3d.com/ (accessed 20 July 2015).

Corresponding author

Greg Sutton can be contacted at: g.p.sutton@derby.ac.uk