Conference Proceedings

Researching Learning in Immersive Virtual Environments

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ReLIVE 2011

- www.open.ac.uk/relive11



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Introduction to Conference Proceedings

Anna Peachey, Conference Chair



These proceedings contain papers presented at the second international conference on Researching Learning in Immersive Virtual Environments, ReLIVE11, held at the Open University campus in Milton Keynes in September 2011.

Three years ago ReLIVE08 was the first international conference to bring together researchers and practitioners with a shared interest in leveraging virtual worlds for teaching and learning. Since then there has been a proliferation of events supporting this growing community around the world. The opportunities for dissemination have also expanded to include dedicated virtual world journals and, launching officially at ReLIVE11, a book series on immersive environments. Research in virtual worlds is becoming established as a field of practice, albeit a very young one, and delegates to ReLIVE08 were pioneers in that movement.

However, we are a smaller group meeting in Milton Keynes in 2011, and the community tells us this is down to a widespread reduction and even withdrawal in funding for conference fees and travel, a symptom of the wider financial climate. Whilst immersive virtual worlds are providing us with platforms for innovation, and new opportunities to understand and address the needs of learners in the 21st century, we are under more pressure than ever not only to continue demonstrating innovation, but to do this at scale, for less money, whilst increasing efficiency and productivity. The challenge for us all is to contribute to a future where innovations meet these requirements whilst keeping learners, and learning, at the core of all that we do. It is this challenge that has informed the focus for this year's event – ReLIVE11: Finding Creative Solutions For New Futures.

In constructing the call for papers, we sought presenters and participants who have experience of designing and delivering learning in virtual worlds across all disciplines, and who have the ability to reflect on and share that experience within an analytical framework. We looked for papers that reflected innovation and that would stimulate discussion among delegates.

The papers that were accepted subsequently cover a wide range of subjects and research methods. They embody a mix of theory and practice, planning and reflection, participation and observation to provide the rich diversity of perspectives represented at the conference.

As is often the case, speakers had limited time in which to present their work at the conference and so the papers contained in these proceedings showcase the detail of their research, approach and outcomes. As with ReLIVE08 some papers reference *"work in progress"*, and the speakers represent a continuum from those with a record of research history in MUVEs up to those who have only very recently started to explore in this area, each with the benefits of their unique perspective.

Presenters outlined their work under the themes of Concepts, Methods, and Implementations *(supported in collaboration with JISC CETIS)*:

Concepts

This theme will propose, draw on and/or extend conceptual and explanatory frameworks for research processes and outcomes for learning in computing, cognitive science, social sciences, education and/or further disciplines. This could include theoretical underpinning for research activities, theories relating to how students, teachers and support staff interact both with and within virtual worlds *(VWs)*, and/or guidance on leveraging immersive environments for learning and teaching in any discipline. It is likely that submissions in this theme will extend our knowledge of theories relating to the research of learning and teaching in VW.

Methods

Submissions under this theme will consider the opportunities and challenges related to researching learning in immersive environments and may for example include papers and/or workshops referencing issues such as planning research, methodologies and research evaluation, data collection and management as well as ethical implications and responsibilities. We anticipate that this theme will contribute to our understanding of the practice of research in VW.

Implementations (in conjunction with JISC CETIS)

Submissions under this theme should focus on the technical aspects and challenges in the implementation of VWs in learning, teaching and research. This could include papers or workshops focusing on the challenges of platform integration *(Second Life, Open Sim et al)* and interoperability with and out with institutional systems such as Virtual Learning Environments, content interoperability *(including Open Educational Resources)* across multiple worlds and multiple use cases, data interoperability and use, for example in assessment and learning analytics, the interoperability of virtual world assets such as avatar interoperability, the merits of open vs. proprietary VW platforms and VW content, and the use of technical standards within VWs to support teaching, learning and research.

Alongside the exciting range of paper presentations, workshops and symposia at the conference we were very pleased to welcome Robin Wight and Andy Piper as our keynote speakers, and Bill Thompson, Ian Hughes and Rebecca Mileham to our Question Time panel. Output from these sessions will be available post-conference at the conference website on www.open.ac.uk/relive11 and I would like to thank all our speakers for their time and input.

All abstracts for ReLIVE11 were reviewed by at least two members of the following academic committee. With many thanks for their input:

- **Andreas Schmeil**, University of Lugano, Switzerland
- **Angela Thomas**, University of Tasmania, Australia
- **Anne Adams**, The Open University, UK
- **Béatrice Hasler**, Interdisciplinary Center Herzliya, Israel
- **Brian Burton**, Abilene Christian University, US
- **Claus Nehmzow**, 3D Avatar School, Hong Kong
- **Charles Wankel**, St John's University, US
- **Daniel Livingstone**, University of the West of Scotland, UK
- **Daniel Pargman**, Royal Institute of Technology, Sweden
- **Dave Taylor**, Imperial College London, UK
- **George Papagiannakis**, University of Crete, Greece
- **Helen Yanacopulos**, The Open University, UK
- **Jeremiah Spence**, University of Texas at Austin, US
- **Julia Gillen**, Lancaster University, UK
- **Kyung Sik Kim**, Hoseo University, Korea
- **Maggi Savin-Baden**, Coventry University, UK
- **Margarita Pérez García**, MENON Network EEIG, Belgium
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- **Suzanne Conboy-Hill**, University of Brighton, UK
- **Claudia L'Amoreaux**, Future of Learning, US

Someone gets to be called Chair, in this case me, but it is misleading to suggest that organizing and delivering a conference is anything other than a team effort. I would like to thank Professor Steve Swithenby, Director of eSTEeM, for supporting the conference and once again I am deeply indebted to the brilliant team who put so much energy not just into making ReLIVE run smoothly, but also into putting the entertaining icing on the organisational cake. My very sincere gratitude goes to the intellectual powerhouse Mark Childs *(jazz hands!)*, the voice of reason and ever-stylish Catherine Reuben *(working that bump)*, the utterly fabulous Helen Yanacopulos *(always welcome in my kitchen)*, the boundless enthusiasm that is Anne Adams and the driving force behind us all, the very wonderful Diane Ford *(knowledge of X-Factor winners a valued specialist subject)*.

I hope that those of you who attended the conference thoroughly enjoyed the experience, and that all of you reading these proceedings will find something to stimulate your thinking and, perhaps, inform your own practice in research in virtual worlds.

With regards

Anna Peachey

ReLIVE11 Conference Chair

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Creation of Knowledge and Student Engagement within Personal Learning Environments

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Abstract

This paper's goal is to examine the student engagement and the creation of student knowledge of undergraduate students using a 3D Virtual Learning Environment. After creating a 3D didactic constructivist virtual environment, student conversations were recorded for engagement dimensions using Hara, Bonk, and Angeli (2000) framework and Nonaka and Takeuchi, (1995) knowledge creation theory. Findings revealed that five forms of student engagement amplified the learning process and that a complete knowledge spiral occurred emphasizing the four modes of knowledge conversion with consideration given to expansive learning (Engestrom and Sannino, 2010). Though limited in time and scope, results further suggest that a highly engaged community of learners was created.

Introduction

Dalgarno *(2002)* argued, *"Three dimensional (3D)* environments have the potential to harness technological developments and facilitate new levels of learner-learner and learner-computer interaction." *(p. 1)* Due to improvements in technology and the utilization of 3D environments on a successful commercial basis *(Blizzard, 2010)*, there has been renewed interest in the utilization of 3D environments as learning tools. 3D immersive VLEs utilize additional technology to provide an immersive environment for the learner to participate. This environment allows the participant to 'touch' and manipulate items in a virtual universe. Three-dimensional *(3D)* VEs come with a myriad of features; though, normally most provide three main elements: the illusion of 3D space, avatars that serve as the visual representation of users, and an interactive chat environment for users to communicate with one another *(Dickey, 2005)*. Salzman, Dede, Loftin, and Chen *(1999)* made a case for the use of immersive virtual reality *(VR)* for the teaching of complex or abstract concepts: Consequently, these *"three-dimensional thematic environment, [were] created with the objective of providing a space where the users can interact" (Kirner et al., 2001)*. Created as cyber Cafés, University classrooms, chat rooms and the likes, these virtual places often become a place where students are afforded opportunities to post suggestions, useful resources and technical advice *(Grubb & Hines, 2000)*. These postings and interactions' serve as knowledge capital that may contribute to a knowledge spiral within the learning environment *(Nonaka & Takeuchi, 1995, Nonaka, 1991)*.

Many researchers have undertaken various projects to investigate aspects of virtual learning environments. Some research has focused on the technical aspects of collaboration such as providing voice with lip-sync *(DiPaola & Collins, 2003)*, others have focused on a specific discipline such as mathematics *(Elliott & Bruckman, 2002)* or science *(Dede, Nelson, Ketelhut, Clarke, & Bowman, 2004)* and others have examined collaboration within a virtual environment *(Burton & Martin, 2010)*. With this increased interest in 3D environments and a desire to utilize the popularity of such environment for the education of the millennial generation

(Dede, 2005), the evaluation of such environments for pedagogical purposes is appropriate. This case study was conducted to add to the body of research where a dialectic constructivist 3D VLE is used to create a learning environment that encourages student creation of knowledge. The following research questions guided this inquiry:

1. Does student engagement within a 3D VLE construct an environment for the four elements necessary for the creation of knowledge?
2. 2) What are the perceptions of the students regarding the effectiveness of the creation of the knowledge spiral within the 3D VLE?

Conceptual Framework

Two conceptual frameworks guided the study: student engagement and knowledge creation theory. Student engagement *(Hara, Bonk, & Angeli, 2000)* was used to explore how students are interacting using reasoning in a 3D virtual environment. Knowledge creation theory *(Nonaka & Takeuchi, 1995, Nonaka, 1991)* was employed by the researchers to identify which of the four modes of knowledge conversion were used in a virtual learning environment.

Student Engagement

Bonk, Kim, and Zeng *(2006)* when surveying higher education faculty who had taught online found, *"Most respondents saw the potential of the web in the coming years as a tool for virtual teaming or collaboration, critical thinking, and enhanced student engagement. (p. 556)*. Primarily these *"three-dimensional thematic environment, [were] created with the objective of providing a space where the users can interact" (Kirner et al., 2001)*.

Identified by Henri *(1992)* were five dimensions that could facilitate assessment of discourse on line. These five dimensions were participative, social, interactive, cognitive, and metacognitive. Reasoning, critical thought and self-awareness are indicators of the cognitive and metacognitive dimensions. However, since the indicators for each of these five dimensions were not clearly delineated by Henri *(1992)* in her work, the coding system used by Hara, Bonk and Angeli *(2000)* informed the indicators for analysis of student engagement in this inquiry. Five reasoning skills form the basis of the framework used by Hara, Bonk, and Angeli *(2000)*. The first reasoning skill is elementary clarification with indicators such as the ability to identify relevant elements and to reformulate the problem by asking pertinent questions. In-depth clarification occurs when the participant can define terms, identify assumptions and establish referential criteria while seeking specialized information and ultimately summarizing that information. Inferencing evolves when the participant draws conclusions, makes generalization, and formulates a proposition. Next judgment occurs when the individual judges the relevance of the solutions and makes a value judgment as to agreement or not. Observation of application of strategies happens when the participant makes a decision that reflects appreciation, evaluation, and even criticism of the solutions. Since a Hara, Bonk, and Angeli *(2002)* classification system lends itself to easier coding it was used in this inquiry.

Knowledge Creation

Baumard *(1999)* called the knowledge creation process *"visible and invisible, tangible and intangible, stable and unstable" (p. 2)*. Much of the research on organizational knowledge creation has revolved around Nonaka and Takeuchi's *(1995)* The Knowledge Creating Company. Nonaka and Takeuchi *(1995)* stated in a simplified overview, *"When organizations innovate, they actually create new knowledge and information from the inside out, in order to redefine both problems and solutions and, in the process, to re-create their environment. (p. 56)* Nonaka *(1991)* postulated that *"creating new knowledge is not simply a matter of 'processing' objective information. Rather it depends on tapping the tacit and often highly subjective insights and intuitions". (p.97)*. In order to have an environment that creates new knowledge, individuals must be given time and processes by which to share tacit knowledge. Nonaka and Takeuchi *(1995)* have identified this process as the four modes of knowledge conversion. This knowledge conversion is essentially the *"interaction between tacit and explicit knowledge." (p.61)* and consist of socialization, externalization, internalization, and combination. In effect, the modes signify a process that begins with shared mental models *(Senge, 1990)*

and spirals through different conversions to become knowledge that is explicitly stated and used in everyday practices. Socialization essentially occurs when tacit is shared with tacit or when an individual learns something new through observation, imitation, and practice *(Nonaka, 1991, p.99)*. However, socialization is limiting because no new insights to the learning has occurred because the learning has not become explicit. Conversely, an individual in a learning environment can collect information from everyone *(explicit)* and from that collective information create new information *(explicit)* resulting in externalization *(p.99*

The person has in essence synthesized the information but has not created new knowledge. However, when tacit and explicit knowledge interacts then powerful learning can occur. This occurs when a learner goes beyond just developing an answer for a problem but creates an innovative way to solve the challenge by taking in the tacit knowledge and interacts that tacit learning with the explicit knowledge of others. *(p.99)* this results in the knowledge conversion mode labelled internalization. After this explicit learning has occurred it will then be shared throughout the learning environment, explicit to tacit, and other learners will begin to utilized these new and innovative learning through the conversion mode of combination. *(p.99)* In fact the other learners use the new learning in such a fashion that it becomes a part of themselves and ultimately of the total learning environment. Thus as argued by Nonaka and Takeuchi *(1995)* new knowledge must first begin with the individual. An individual's knowledge can then be transformed into group knowledge when certain knowledge creation modes exist *(Nonaka, 1991)*.

Since the research within 3D VLEs is limited in scope, and while some promising research has been conducted within 3D VLEs, significant research is still lacking. In this case study, a 3D virtual learning environment utilizing a dialectic constructivist approach was constructed. Next, learners were given a project which provided the organized scaffolding for learning and the opportunity for the learner to create knowledge with other learners to further develop their opportunities for learning.

Experiment

Quantitative data were gathered using the 3D VLE that allowed the participants to communicate with one another through a built in chat system. Additional quantitative data were gathered through a follow-up survey that contained open-ended questions and a purposeful sample of interviews. The interviews, survey and communication from the 3D VLE provided triangulation of the quantitative data.

Conversations were evaluated using Hara, Bonk, and Angeli *(2000)* system of classification to check for collaboration. This system creates five *(5)* categories of classification for conversation based upon the purpose of the conversation. Elementary clarification is the observation or studying of a problem, usually indicated by identification of relevant elements. In-depth clarification is the gaining of a deeper understanding of the problem. For inferencing, the participant has made an induction or deduction toward solving the problem. In judgment, the participant has made a decision or evaluation of the problem. Finally, application is the coordinated action or application

Population and Sample

The sample of this case study consisted of twenty-eight college students at a small, public college in the Midwest and a small private college in the South-central areas of the United States enrolled in computer game programming courses. Both sets of students were enrolled in courses designed to teach the fundamentals of game design and development. Seventy-five percent of the students were male and ten percent were minority. The sample was drawn from a population of 1600 students attending an open-admissions two year campus and 4800 students attending a private, religiously-oriented campus. Within the population of the public campus comprising 1660 students, 47 percent are full-time, 65 percent are female, 35 percent are male, and 55 percent are traditional college students. The population of the private campus comprised 4800 students, 86 percent are full-time, 55 percent are female, 45 percent are male, and 89 percent are traditional college students. While students at the public college typically considered

minority are few in number *(4%)*, the students attending this university are economically and educationally disadvantaged *(89% receive financial aid, 74% require one or more developmental education course)*. The private college had a higher diverse enrollment with 21% being classified as minority.

Data Collection and Instrumentation

Used during the course of this research were two methods of data collection. First, as a part of this research it was necessary to create a dialectic constructivist 3D Virtual Learning Environment to see if student engagement and knowledge creation occur within such an environment. The 3D VLE utilized the Torque Game Engine produced by Garage Games *(2006)* and was developed and modified by one of the researchers. Specifically, the Torque Game Engine was modified to create an environment that enabled learners to interact in a dialectical constructivist environment that facilitates student engagement and knowledge creation *(Dalgarno, 2002)*.

3D Virtual Learning Environment

The target group of participants for this study was students enrolled in computer programming courses. An intended outcome of this project was to improve the programming skills of these students and give them experience in programming and working with a 3D game engine. To that end, the 3D VLE was created and equipped with male and female avatars, several tank designs to which the participants would eventually apply basic artificial intelligence, and a virtual environment in which the participants could interact with one another. Additional, kiosk stations were placed in the environment to provide directions and clues to the participants.

The process of collaboration within the 3D VLE was a three step process *(see Figure 1)*. Participants created their own account which enabled them to connect to the chat database. After login, the 3D VLE enabled the participant to then connect to a Master Game Server, which provided a link to the hosted game. All chat messages were saved on the Chat Database and forwarded to all active participants through the hosted game.

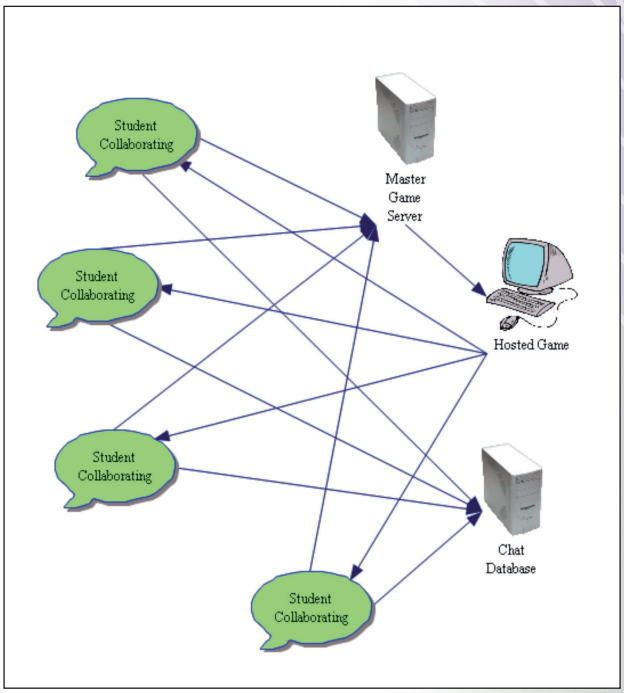


Figure 1 Participant – Server interaction.

Data Analysis

Utilizing the framework proposed by Hara, Bonk, and Angeli *(2000)*, student interaction was categorized into five classifications:

1) Elementary clarification – observation and identification of a problem and its elements. This includes identification of linkages to gain a basic understanding of the problem.
2) In-depth clarification – gaining an understanding of the problem so that it *"sheds light on the values, beliefs, and assumptions which underlie the statement of the problem" (p. 125)*.
3) Inferencing – Use of induction and deduction in the analysis of the problem.
4) Judgment – Making a decision.
5) Application of strategies – *"proposing coordinated actions for the application of a solution" (p. 125)*.

Next, the dialogue between the students was analyzed using the four modes of knowledge conversion of socialization, externalization, internalization, and combination. Socialization essentially occurs when tacit is shared with tacit or when an individual learns some new through observation, imitation, and practice *(Nonaka, 1991, p.99)*. Externalization occurs when an individual collects information from everyone *(explicit)* and from that collective information create new information *(explicit)*. *(p.99)* Internalization occurs when a learner

creates an innovative way to solve the challenge. *(p.99)*. After this explicit learning has occurred it will then be shared throughout the learning environment, explicit to tacit, and other learners will begin to utilized these new and innovative learning through the conversion mode of combination. *(p.99)*

In summation, the qualitative data were analyzed in a multi-step process to ensure triangulation of data. First, the quantitative data of frequencies of interactions which measured engagements were computed to aid in the analysis of qualitative data. Second, qualitative data from the actual conversations recorded in the research was coded and classified.

Discussion of Findings

The researchers examined the student engagement by utilizing qualitative data gathered from the chat records of the 3D VLE. The chats captured from the 3D VLE provided a rich texture of collaborative data. Of the 682 conversations that occurred during the two weeks of data gathering, a vast majority *(62.6 %)* were found to be collaborative in nature *(see Table 1)*.

Table 1 Number of Chat Conversations by Classification. N=682

Classification	Conversations
Elementary Clarification	201
In-Depth Clarification	92
Inferencing	35
Judgment	37
Application	62
Off-topic	174
Salutations	67
Flaming	14

Initially, the majority of conversations were off-topic or focused on learning the environment. However, participants were able to easily move and communicate within the 3D VLE (see Figure 2). After approximately two and a half (2.5) hours of working inside the 3D VLE, there was a dramatic drop in off-topic conversation. At this same point, there was a noticeable change toward student engagements through conversations that were seeking in-depth clarification and application. From the surveys, several comments were made concerning the initial general engagement: As one student said, "Most of it was us helping each other understand the mechanisms of the environment, figuring out what was tied to what." Another student found that the student engagement through dialogue allowed for the "clarification of goals, discussion of problems, fun banter, answered questions that others raised, and some arguments when misunderstandings arose."

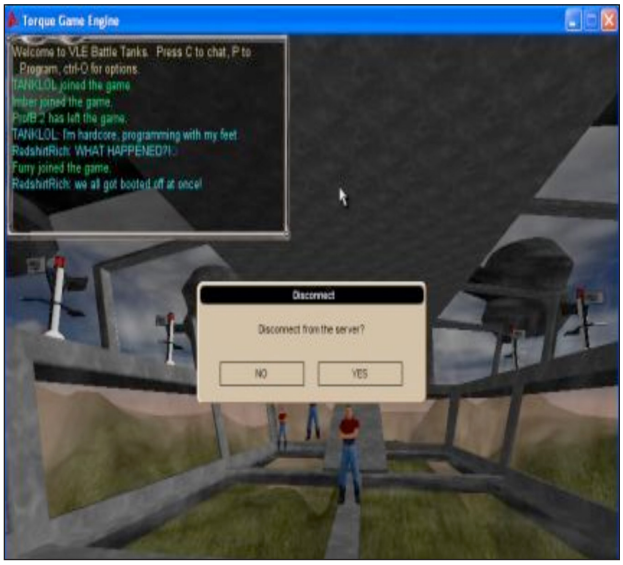


Figure 2 Conversations within the 3D VLE.

Again using the data from the 3D VLE the researchers analyzed the conversation data through the framework of Nonaka and Takeuchi's *(1995)* knowledge spiral. The beginning of the knowledge spiral must show the transference of tacit knowledge to explicit knowledge, passing through the four modes of knowledge conversion: socialization, externalization, combination, and internalization. This process became evident from the chat records recorded in the 3D VLE. One example of the Knowledge Spiral is presented:

1. RedShirt_Rich: *"The Prof says he switched to code on the CLIENT side only for switching between characters"*
2. Furry: *"Yeah but it is set up differently than the tank code"*
3. Furry: *"he is calling to two different cs files instead of one"*
4. RedShirt_Rich: *"Whatever he switched turned off the animations, and I'm not sure the server would EVER see the Ava model..."*
5. RedShirt_Rich: *"...if the server side code doesn't have the new selection methods"*
6. Furry: *"let s throw in blue man to see if the code is defaulting to the player.css"*
7. Imber: *"hey is the problem of not showing the animations and not loading av in the aiplay.cs?"*
8. Imber: *"OMG i got the animations to work..."*
9. Imber: *"all problems are in the aiPlayer.cs"*
10. Furry: *"That's why the[y] have to be in the same file"*
11. *Red*Shirt_Rich: *"No[w] what?"*
12. Imber: *"w[ait] ill change to adam"*
13. Imber:*"ok thats weird"*
14. Furry: *"See you broke it :)"*
15. Imber: *"Whatever the server host chooses gets cast to all other players"*
16. RedShirt_Rich: *"Ava's animations worked for servers AND clients. Adams s animation ONLY works on the Server.*
17. Imber: *"the call backs need to be uncommented and the male needs to be taken out of the aiplayer.cs file"*

In this sample of conversations, the students completed all four (4) of the modes of knowledge conversion: socialization, externalization, combination, and internalization. During the socialization process, tacit knowledge is shared with other students. From the data, one can see the students start out by collaboratively sharing what they have learned by experimentation and from others. In Statement 1 and 2 of the conversation, RedShirt_Rich and Furry discuss what they have learned thus far from others and observation inside the 3D VLE. This socialization process ensures that they are both at the same starting point as they prepare to address the avatar and animation problems in the learning environment.

In the externalization conversion of tacit to explicit, a hypothesis is proposed as to where the problem is located. Statements 3 through 7 represent this move from tacit to explicit. Furry notes to RedShirt_Rich that two data files are being accessed in the computer program instead of just one data, which they had seen in another example. RedShirt_Rich makes a hypothesis that this might be the cause of the animation problems. Furry (in statement 6) proposes a method of checking to see if this might solve the problem. At this point, Imber, in statement 7 notes that the problem being discussed seems to be originating from one data file, beginning the transfer to the combination mode.

As the students move into the combination mode, students create a structure for the problem and attach it to one location with the program files. Statements 8 through 14 show the development of the structure and application of the hypothesis developed in the externalization process. Imber initially believes he has solved the problem by making a change to the data files. As he further applies the hypothesis, it creates other visual problems within the 3D VLE, causing Furry to, in good natured fun, tell him that he just broke the system.

During the final internalization phase of the Knowledge Spiral, the students take what they have learned thus far and apply it. In statements 15 through 17, the three students discuss what was done to create the differences in the virtual environment and what files were edited. This creates new observations about the problems that they are addressing, which starts a new cycle of the Knowledge Spiral. Thus the data reveals that the 3D VLE provides and supports opportunities for the students to practice Nonaka and Takeuchi (1995) Knowledge Spiral, which they refer to as "learning by doing" (p. 69). While the students do not completely resolve the problem in this conversation, it does form the bases of future conversations of tacit to explicit knowledge creation that eventually leads to a solution being proposed.

Nonaka and Takeuchi's (1995) framework of cyclic knowledge creation, based on conversions between tacit and explicit knowledge was the learning theory we initially used to analyze the learning process in the 3D virtual environment. Their model notes four basic actions in knowledge creation: socialization, externalization, combination, and internalization. However, one of the essential challenges we observed with the Nonaka and Takeuchi's model is the assumption that the project for knowledge creation is given from the instructor. In other words, what is to be learned and created is arguable a management decision that is outside the bounds of the local process (Engestrom, 1999). This assumption ultimately leads to a model in which the learning consists of non-conflict interactions, or as Nonaka and Takeuchi (1995, p. 45) noted the creation of 'sympathized knowledge'. Ahonen et al, (2000) argued that knowledge should be embedded and constructed in collective practices instead of being an individual property, trait, or skill that can be identified, codified and measured by objective evaluators (p. 283).

Therefore, we suggest that along with the knowledge spiral of Nonaka and Takeuchi (1995) that the creation of knowledge and student engagement in a 3D virtual environment can be understood through understanding the expansive learning theory (Engeström 1987, 2007). The process of expansive learning involves actions that we suggest allows students in a 3-D virtual environment to create knowledge and engage in learning. The theory of expansive learning focuses on learning processes whereby the assignment or learning task is transformed from individual students to communities of learners through questioning and challenging of issues (Engeström, 2001). A state of need in an activity, or in this case a problem, is the beginning action of expansive learning. Generally, students question¬ing the task given to them in a learning environment discover this state of need. The questioning relates to primary contradictions of an activity that are covert in the learning environment. These primary contradic¬tions can become explicit only through lexis of double binds in an activity. Engeström (1987) argues that double binds experienced by students are mental examples of secondary contradictions that can act as agents of change (p. 165). In effective actions of expansive learning, participants analyze the contradictions and tensions inherent in the learning and create [model] new solu¬tions for the task or problem. During the analysis and modelling, the creation of a new task or problem is created. Analyzing and modelling are followed by the examining and testing of the new model resulting in adjustments and enhancement of the task. During implementation, contradictions between the old and new models of a task occur. Next reflection refers to evaluation and stabilization of the process (Engeström, 2007). After evaluation, the consolidation and generaliza¬tion of the new practice takes place. Consolidation and generalization can trig¬ger contradictions between the new task and other tasks, for example in collaboration between problem one and problem two in the 3-D virtual environment (Engeström & Sannino, 2010, p. 8). In essence the process of expansive learning involves the questioning and analyzing of an existing problem as well as modelling and implementing a new problem (Engeström & Sannino).

Engeström and Sannino (2010) further posit that currently the theory expands its analyses up and down, both outward and inward. They noted by moving up and outward, the theory applies to networks of interconnected activity systems with their partially shared and often contested objects. However, the theory by moving down and inward, deals with issues of subjectivity, emotion, embodiment, identity, and moral commitment. This process of expansive learning represents the progression of mutual learning during which a new shared task or problem is created through solving contradictions and mobilizing the available social and cultural resources in the problem (Engeström, 2007).

Conclusions

In this inquiry, one key finding was, individually, students assumed a myriad of roles to solve the problems. Some began as the leader, then switched to the encourager then perhaps back to the leader, etc. Furthermore, the majority of the students appeared to engage in the content and the context of the learning using the entire dimensions of reasoning skills as postulated by Hara, Bonk, and Angelis' (2000)

framework. Also according to Hara, Bonk, and Angeli (2000), the frequency of the social cues might be an indicator of the level of learner engagement on the learning task. As one can see from the data set, the frequency of the social cues were high throughout these courses as the students continued to solve the problems, even as the student messages because less formal perhaps due to students feeling success collectively in solving the learning tasks or perhaps they were just more comfortable with each other (Kang, 1998).

Consequently, in studies comparing face-to-face to computer-mediated communication (Walther, 1996), it has been reported that students do develop social relationships similar to those in a face to face class but generally it takes longer. However, the data from this inquiry found that students after just a short time frame settled into an engagement that was focused on solving the problem(s) yet went outside the arena of the virtual environment to have phone conversations and hold discussions via emails. Thus, it can be concluded that a 3VD learning environment can enhance the reasoning skills of the participant, if designed in such a fashion that a significant amount of engagement between the participants is provided to resolve the issue. The design of the pedagogy of the virtual learning environment is essential to this myriad application of reason skills.

To assess the extent of knowledge creation the learners with other learners, we utilized Nonaka and Takeuchi, (1995) knowledge creation theory. Those researchers theorized that the active creation of knowledge progresses through four phases, and that while not every instance of socially constructed knowledge may move spirally through each successive phase equally, they are nonetheless consistent with much of the literature related to constructivist knowledge creation. As Wulff, Hanor, and Bulik (2000), noted that the instructor can aid the development of collaboration within a constructivist approach by "redistribut[ing] learning control and power by supporting and/or developing interaction-exchange formats, such as synchronous and asynchronous chat sites and display rooms to cultivate social and individual presence." (p. 150) This non-foundational view of learning allows students to learn in a collaborative fashion, rather than with the traditional foundational view in which knowledge is dispensed from the teacher (Bruffee, 1999) was the focus within the creation of this 3VD learning environment. This effective constructivism allowed for the creation of knowledge for the learner (Fosnot, 1996).

Consequently, a second key finding from this inquiry is that a well-constructed 3D virtual learning environment should be designed around a knowledge creation focus to be effective. Within this knowledge creation focus, then new knowledge can be categorized and contextualized in an effort to make it accessible and of value to the widest range of students. Thus it can be concluded some the of design will incorporate the "soft" knowledge of how to engage the students throughout the course in a meaningful and a critical thinking process, while allowing for students to reflect and discussion in such a way that the knowledge creation spiral is established that reflects the four dimensions. Of course just as valuable is the new "hard" knowledge that incorporates the actual educational tool one uses to create the virtual learning environment.

Implications for Practice

The implications for practice focus almost entirely on how the teacher designs the 3D virtual learning environment, first understanding that dialogue and collective reflection must exist. The virtual learning environment must be designed to allowing the learner's thinking to be observable, learners must be allowed to engage in reflection in different phases of problem completion. Designers should include a model of the process of reflection, by providing examples of experts' thinking. Moreover, multiple perspectives can become apparent by providing ample opportunities for collaboration through dialogue and reflection.

Secondly time and space for student engagement must be in the forefront of design. Designers must create group problem based projects that give students extra motivation to work with others in the class and share ideas. In online contexts, instructors must strive to optimize interaction between learner-instructor, learner-learner,

and learner-content through effective modes of communication *(Chen & Willits, 1999; Jung, 2000)*. The facilitation of dialogue must involve an evaluation of the opportunities for dialogue as well as an analysis of the quality of the dialogue that occurs *(McBrien, Jones, & Cheng, 2009)*.

Next, the designer of the virtual environment must provide networking opportunities and the linkage of explicit knowledge. To encourage knowledge sharing and creation in an online or 3D VLE course, the instructor must develop trust by allowing students to participate in activities that build on personal social contact. Within the virtual learning environment, there must be collective conversation and sufficient time for exchanging ideas. The instructor can establish incentives for those who share their knowledge, allowing capacity building leading to enhanced creative thinking. Finally the instructor must encourage students to admit knowledge gaps and problem failures which will lead to more risk taking within the environment.

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“Poetry in the raw”; the use of avatar names in the development of identity in virtual worlds

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Abstract

Previous research (Childs, 2010) indicates that a prerequisite for effective learning in virtual worlds is for the learners to develop an identity and sense of embodiment within the virtual world. Educators must therefore include the development of identity as part of their introduction to virtual worlds they provide to students, part of which is through the personalisation of the learners’ avatar, a so-called “Design for Dasein”. Identity development is therefore to be integrated into a standardised course to be delivered by Larysa Nadolny and colleagues at West Chester University and collaborating institutions.

The initial step in identity development is the choice of a name: a fundamental step in that it influences the remainder of the participant’s interaction in the virtual world (Truelove and Hibbert, 2008). Research by Marianne Riis of the ICT and Learning Master’s programme at Aalborg University identifies many of the various factors that influence the names chosen by learners, and how this may indicate the nature of the learners’ relationship with their avatar.

In this paper, the work of the three authors in three studies is drawn together as an example of how theoretical underpinnings and direct observation of students may be incorporated into introductory courses to virtual worlds, and thereby provide an effective scaffold for learners adapting to learning in a virtual world.

New readers start here: the research published to date by the authors

Previous research undertaken by the authors *(e.g. Childs, 2009)* indicates that learning activities undertaken in virtual worlds are more effective if the learner experiences a sense of presence within the virtual world. The correlation is not absolute, however it is strong enough to be able to state that those students who experience presence within a virtual world will almost certainly be the learners who find the experience a satisfying one; those who do not experience presence are very likely to be the learners who do not.

Presence exists in many different forms: this includes a sense of virtual presence, i.e. a sense of *“being there”* within the virtual world; co-presence *(a sense that one is sharing the space within the computer-generated world with other people; social presence (when someone can both perceive the individual nature of the other participants and convey their own personality)*; and, perhaps the most difficult to develop, a sense that their own virtual self, and virtual body, is to some extent *“real”* within that environment *(called “embodiment”* or self-presence) and the perception of it in relation to the space. Furthermore, interviews with, and observations of, students, indicate that the ability to

experience these different forms of presence develop over time and this development can be described as a series of stages *(while acknowledging that these stages are not completely distinct and not necessarily consecutive)*.

The first stage that learners encounter is the need to acquire the skills required for basic navigation, communication, and interacting with objects, as well as how to recover from a software crash and return to their original location. Before this stage is completed, learners are not in a position to use the platform to learn anything further; their focus is the platform itself. This relationship to the technology is known as hypermediacy, i.e. their awareness is of the medium itself, rather than the space presented by the medium *(Dobson, 2009; 2)*. The successful tasks set for the students are those that relate to the technology, rather than the objects within it. Once these skills are acquired, the technology can be operated without particular conscious focus and becomes less noticeable; described as immediacy *(Dobson, 2009; 2)*. Activities can be accomplished which employ the technology as a window through to tasks and information located within the virtual world *(for example more curriculum-related)*.

These stages are no different than that experienced by anyone learning a new technology to accomplish a task, and are simply the progression from unconscious incompetence to unconscious competence noted by Dubin *(Childs, 2011)*. If the virtual world is to be used solely to convey information to the learner *(e.g. the design of a particular theatre, the hazardous places around a building site, information about sexual health)* then simply being able to navigate and communicate competently will probably be sufficient. However, many learning activities located in virtual worlds are based on providing learners with an opportunity to take part in experiential learning, and to socially construct knowledge. Virtual worlds have a unique potential to enable these sorts of learning, through their use of avatars to position the learner directly in connection with the environment and other learners; however, it is these unique features that also place higher demands on the learner than other environments. Taking part in social interaction *(and hence social constructivist learning)* is enhanced by the development of social presence *(Caspi and Blau 2008; 339)*, and a prerequisite for this is the formation of an inworld identity. Experiential learning is enhanced if we have a strong sense of self-presence within the environment *(Biocca, 1997)*; developing this sense of self-presence requires us to not only be able to move the avatar, but to be so familiar with its movements that it becomes an extension of our selves. Thus, for those learning activities that have a social and experiential component to be as effective as possible, learners must first be given the opportunity to develop a virtual world identity, and feel embodied within the environment.

Design for Dasein

These ideas of embodiment and presence in online experiences are prefigured in other contexts, such as the concept introduced by Heidegger in the 1920s of Dasein *(Dreyfus, 1991; 15 – 16)*. Dasein means literally *"being there"*, and can be interpreted to mean that our existence is grounded in the physical location of where we are; we are not merely present in a space, our existence is constructed from our relationship to that space *(although interpretations of what the phrase means vary (Dreyfus, 1991; 141 – 144)*. Heidegger's concept of Mitsein or *"being with" (Dreyfus, 1991; 145)* also prefigures the concept of copresence. Referencing the concept of Dasein is useful in three ways, firstly it highlights the fact that conceptually people have struggled with being and embodiment for many years in relationship to the physical world; secondly, it formed the ground for later writers to develop, such as Husserl, who drew a distinction between the 'objective' body *(Körper)* and the 'lived' body *(Leib) (Smith, 2007; 5)* and Merleau-Ponty, who described a body as situated in a space, as opposed to merely located in that space, i.e. with a relationship to the objects and tasks surrounding it *(Smith, 2007; 16)*; and thirdly, and chiefly, because it gives us an opportunity to use the pun in the heading at the beginning of this section.

The goal, then, in providing learners with sufficient grounding in the use of the virtual world is for them to become enabled with a sense that the avatar not only represents them on the screen, locating them within that space, but it is situating them in relationship to the other avatars, to the tasks they are to

undertake and to the environment in which they are performing those tasks, as a lived body. For example, in the study by Childs and Kuksa *(2009)*, students with only two hours' experience of Second Life were taken on a field trip around various theatres there and asked questions on the spaces as potential locations for performance. Although able to comment on the suitability of Second Life as a medium *(a question which called on their experience of a window at the technology)*, they were not able to respond to the question of how they felt a performer would have felt in the theatre in the physical world that was being simulated in the virtual. Their responses indicated that they did not feel sufficiently embodied within the environment to form an emotional response to the space. A later study with students who had spent several months in Second Life indicated that by this stage they were able to form an emotional response to different environments. Their descriptions of their time inworld indicated that three things had led to this development of a sense of embodiment; these were:

- Experience. This is both in terms of length of time inworld and exposure to a number emotionally affecting activities; moving ones, such as the Holocaust museum, and fun ones, such as snowboarding.
- Personalisation. The learners had, on the whole, experimented with appearance and settled on a form and outfit that they felt comfortable with. Shopping, experimenting *(such as being a robot made out of cardboard boxes)* and spending time fine-tuning their costumes all helped them feel connected to their avatar. A few reported that they did not feel the need to do this, as they felt connected with the generic avatar they adopted when they first entered the world, but they had reflected on their identity and deliberately chose to keep this form.
- Intention. The learners all had discovered some aspect of the world that drove their continued interaction, beyond that of the designated learning activity. For some this was simple exploration, others enjoyed the randomness of simply teleporting. A desire to excel at the learning task also motivated learners to feel part of the world *(Childs and Chen, 2011)*.

The importance that personalisation of one's avatar has in supporting learning is demonstrated by the work of Gonzalez, Younger and Lindgren *(2011)*. In their experiment a group of students were given the task of creating an avatar in Spore *(an MMORPG)* that reflected their personality. Half of the students then had their personalised avatar swapped with a generic one. The students were then set a series of tasks in that world. The researchers found that the students who used their personalised avatars were more engaged and had better recall of the activities than those who used the generic avatar.

The conclusion is that if we want our students to be effective learners in the virtual world, then we need to support the development of their sense of presence in that world. This means providing them with emotional experiences that add to their sense of being situated within that space as well as providing them with the tools to personalise and fine-tune their avatar's appearance. We also need to give them a range of opportunities to pique their interest in the virtual world as a medium, as well as present convincingly the rationale for the learning activity to actually be in a virtual world, since without sufficient motivation not only will the task seem pointless, but they won't feel as if they are really *"there"* within the learning space.

The next phase: developing an introductory course for students.

There are several guides to introducing students to virtual worlds, based on direct observation of a range of case studies, and drawn from practitioner experiences. The outcomes of several projects, such as the PREVIEW project, *(Savin-Baden et al, 2009)*, the PREVIEW-Psych project *(Bignell and Parson, 2010)*, the Open Habitat project *(Cormier et al, 2009)* and the DUCKLING project *(Wheeler and Salmon, 2009)* include not only manuals on the functionality of the software, but also guidelines to proper behaviour inworld, and series of activities to introduce newcomers to the environment. Despite these case studies all taking place in Second Life, because most virtual worlds

used in education use similar *(if not the same)* viewers, and adhere to similar standards, these have a general applicability. Since these materials have been tried and tested in the year or so following their creation, this could be an opportune time to synthesise these materials and develop a systematic introductory course for learners new to virtual worlds.

The development of this single course does not only have value in merging the best of current practice, but also some element of standardisation enables educators to identify the levels of prior experience of their students. As courses held in virtual worlds become more common, the possibility of students entering a course with some previous experience of learning in virtual worlds becomes more likely. Identifying precisely what this previous level of competence is would be a valuable tool for educators. In online workshops too, it is frequently the case that attendees arrive with insufficient experience of navigating and communicating using the platform, and often a demonstration or field trip is sidelined into providing support for these attendees. A solution, mooted at previous inworld conferences, is for a commonly recognised standard description of competency to be required for entry at the workshop *(Jane Edwards, Shri Footring, personal communication)*, sometimes described as an *"Avatar Driving Licence"*. Independently, others have recognised the need for the same *(Anna Peachey, Greg Withnail, personal communication)*.

The issue with such an introductory course is that for most educational classes, dedicating time to inducting learners into the use of the software takes away from the time available for teaching the syllabus content, providing students with the opportunities to develop a fully-fledged identity within the environment would not be appropriate when the syllabus only calls for a single two-hour learning activity, for example. Any such standard introductory course would need to have different levels in order to provide the appropriate introduction for the learning tasks.

Initially beginners would be able to achieve the basic competencies in operating the viewer, that is logging in, navigating, communicating and interacting with objects; intermediate level would involve the identity development and embodiment levels described above; advanced would require students to understand the social aspects, or the community aspects, and/or basic building and scripting. Beyond this, the assumption is that advanced building and development skills would be beyond the remit of an introductory course and would be unlikely to be prerequisite skills for most educational courses.

The opportunity to develop this standardised *"avatar driving licence"* arose during the summer of 2011, due to the research funding supplied by Hewlett Packard to the SciEthics Interactive project. This project aims at presenting students with simulations in OpenSim focused on science content, and then pre- and post-test the students on their ethical decision-making with respect to the situations presented *(Nadolny et al., 2011)*. The *"Global Expansion"* of this project involves the inclusion of additional universities *(SUNY Empire State College, New York; National University, California; and Univeristy of KwaZulu-Natal, South Africa)* and developing common precursor courses to run across all of the educational courses held. These precursor courses will be optional, some of the learners will opt to take them, others will not. We anticipate that the basic level, that of navigating, communicating and interacting with objects will be taken by all students, but the intermediate level, in which students personalise their avatars and explore their identity, will not be so widely taken up. The intention is to measure the learning gains of the two sets of learners and see whether the difference in pre-test and post-test scores amongst those who have taken the precursor course is different than those that did not. The hypothesis *(indicated by the experiment of Gonzalez, Younger and Lindgren [2011])* is that the students who have worked on developing an identity inworld and use their personalised avatar for the science simulation activities will be more engaged and learn more effectively.

At last we get to the bit about names

Developing a standard introduction for learners is only part of what is planned; the intention is also to develop an understanding of learners' experiences in specific stages of the process, and identifying key factors and incidents that promote or impede their sense of identity and embodiment. These analyses will, it is hoped, enable us to optimise the process. The example of the analysis of naming, described below, indicates the manner in which we plan to incorporate wider research *(and conversely use our analysis of learners' experiences to inform further research)*. As the programme develops, other stages in the development of learners' identity and embodiment will be explored.

As Savin-Baden et al *(2009; 5)* note, a key part of creating presence in the virtual world occurs before the learner even enters the world for the first time, this is the naming of the avatar. Learners have to make a choice before, on the whole, they are aware of the significance or purpose of the name *(Debra McCormick, personal communication)*. Thus the creation of a name has to happen as the first task and therefore is out of synch with the rest of the work; identity development has to begin before basic skills are mastered.

Solutions for this vary. In Childs and Kuksa *(2009)*, students were given dummy accounts in Second Life for their initial sessions, so that they could develop their basic skills and gain some formative experience of presence before taking on the task of choosing a name. Truelove and Hibbert took a similar approach, providing their students with an opportunity to enter a private OpenSim environment as a *"test user" (2008; 360)* before exposing them to the wider social world of Second Life in which the majority of the learning activities were to take place. They note that the wrong choice of name at an early stage can influence a user's long term identity, and that learners are often overwhelmed by the amount of skills that are needed to be acquired, and by the demand to perform an inworld identity from the first moments of exposure. Providing an opportunity for learners to learn the basic skills, as well as conduct tasks such as building, before social interaction has to take place means that the skills can be developed more slowly, issues of identity portrayal can be deferred until the learners are more confidant *(and have begun to develop an inworld identity)*, and *(since building is one of the early tasks set them)* learners can see the rationale for using the virtual world platform that much sooner and so be more motivated to participate. Once these initial stages were passed, Truelove and Hibbert also spent considerable time scaffolding the name-choosing process *(ibid; 362)* with classroom-based activities in which learners selected different potential names and researched their significance, before creating an account with that name. When the learners did finally enter Second life, they did so with much more confidence than before this initial scaffolded pre-registration activity was introduced.

During the period over which the authors' participation, teaching and research in virtual worlds has been taking place, the policy under which the leading platform for education in virtual worlds, Second Life, has changed. Originally when signing up for a Second Life account, new users were given the choice of any forename they liked, but then selected a surname from a preset list. It would then be likely that this combination was not available, and the process would need to be restarted. This meant that having an avatar name that was different from their physical world name was mandatory for participants, and this name was usually Western European in origin. The current policy is for participants to be able to choose whatever name they wish, and are then given the stock suffix of *"Resident"*. Users can also choose to show whichever name they wish as a *"display name"*.

The choice of re-using one's real life name or creating a new name is an augmentationist versus immersionist issue. Bennetsen *(2006)* notes these two modes as the dominant ones in which activities take place within virtual worlds and which have quite different rules and conventions that govern behaviour. When used as an environment for augmentation activities, the virtual world is perceived solely as a platform for extending relationships that take place in the physical world; people's physical world identities tend to be known, and there is no sense of roleplay, or adopting different conventions from the physical world.

Participants who conduct immersionist activities, however, will adopt new conventions for the virtual world, and may not adhere to their physical world roles. Bennetsen notes that they rarely reveal their physical world identities, not disclosing personal information within their profile and using text rather than voice to communicate. They see the virtual worlds as a self-contained space separate from the real world.

- Your SL and RL identity are two different sides of you that should not mix... This separation of the two gives you the freedom to live your second life in a way that you might not feel able to do in your first life. *(Bennetsen, 2006)*.

Experiences from the MIL programme

Marianne's research

Over the past few years, Marianne Riis has taught a Masters' degree programme in ICT and Learning *(MIL)* at Aalborg University, much of which is based in Second Life, and has studied the inworld classroom interactions and the community of practice that has developed around the class.

The students in the first *(2007)* group were given no particular instructions related to avatar creation or choice of names, and the issue of names was hardly mentioned by the students. Later classes were given instructions and the number of students who chose to use their real names decreased.

Observations from in-world over four cohorts of students *(beginning with the cohort that started in 2007 i.e. MIL07)* show that the students made very different decisions about their choice of names. Table 1 shows an overview of the students' avatar names and their resemblance to their physical world names.

Students who keep their physical world name

Over the four cohorts seven students *(14%)* chose to maintain their physical world first names for their avatars, explaining that this choice made the names easier to remember, and made themselves easier for others to identify with their avatar. In MIL08 one student who chose to keep his physical world name, was asked by one of the other students to elaborate on this choice, and explained:

	Physical world name	Physical world name resemblance	No physical world name resemblance
MIL07 (n=19)	**3** (15,8%)	**5** (26,4%)	**11** (57,8%)
MIL08 (n=12)	**2** (16,7%)	**3** (25,0%)	**7** (58,3%)
MIL09 (n=8)	**1** (12,5%)	**5** (62,0%)	**2** (25,0%)
MIL10 (n=11)	**1** (9,1%)	**3** (27,3%)	**7** (63,6%)
Total (n=50)	**7** (14,0%)	**16** (32,0%)	**27** (54,0%)

Table 1 Overview of avatar names' resemblance to physical world names.

> *"Yes, I chose my own name because of convenience, didn't have much imagination to create a more exceptional name, I just wanted to get started quickly when I signed up. Afterwards, I've become fond of my name – it eases things in relation to the course. I find it difficult to remember who is hiding behind some of your cryptic names and find that in relation to a learning context it would be better to maintain the student's own name." (Student 08 A).*

This need to easily identify who the physical world person is behind the avatar was noted by Jones *(2005)* in reference to a research project in Active Worlds.

> *"The concern with names was persistent and the project participants were very keen to know the real identities behind the avatar. Exchanges took place that either established or confirmed a participant's offline name and identity and associated it with the avatar." (Jones, 2005; 419).*

Indeed in some virtual worlds, the convention preferred by the hosting company is that one uses one's physical world name for an avatar name; Active Worlds Europe being such a case *(Emmanuel Grijs, personal communication)*. The case reported by Jones was based on text communication and although in the MIL cases, voice was used, this did not necessarily translate to the students being able to identify each other, since the students only met face-to-face four times a year.

This preference to be able to identify the physical world identity is known as disclosurism by members of the virtual world communities *(Amdahl, 2007)* and exemplifies the differences between the augmentationist and immersionist viewpoints, with augmentationists viewing lack of disclosure as deceitful *(cf. Student 08 A's reference to "hiding")* and immersionists viewing others' requirement to disclose as a distasteful preoccupation with the physical world, or worse, an attempt to invade their physical world privacy. Disclosurism actually seems linked to the perception by some that interactions that are based solely within the virtual are inauthentic, these participants then feel anxious that they don't know who the people with whom they are talking *"really are"*. This perception of inauthenticity may in turn have its roots in a lack of embodiment and presence within the environment *(Childs, 2010; 221)*.

Students whose avatar name resembles their physical world name

A third of the students chose an avatar name that was not exactly the same as their physical world name, but resembled it to some extent. This could include part of their name*(s)*, abbreviations, contractions, and/or by addition/subtraction of one or more letters *(none used numbers)*. One MIL08 student, who chose a name with a clear resemblance to her physical world first name *(by simply adding two letters)*, agreed on the convenience aspect and also referred to this name being part of a pre-existing online identity and the use of the name enabling her to draw on that:

> *"Several of us have chosen because of convenience - [her avatar name] – this I can remember, and I also use it in other places on the internet, and it is sufficiently close to my own name, so I don't feel completely alienated." (Student 08 B).*

Other students explained their choices in the following ways:

> *"Ciao Ragazzi. I'm now in SL as [RL name changed a bit to sound more Italian]. I feel like an Italian, and love everything Italian, and this is also why I'm dressed in my new Ferrari t-shirt. Tanti saluti." (Student 08 C).*

> *"Her first name is a contraction of my own names. Her last name is Gartner, partly inspired by Howard and his theory on learning, which was a big mantra in my time at Teacher College, partly because I love to spend time in my garden, when I'm not sitting by my computer." (Student 09 A).*

Students whose name bears no resemblance to their physical world name

The majority, 27 students *(54%)*, chose to create names with no resemblance to their physical world names. Again, this did not mean that their names were not related to the physical world at all. Six students deliberately chose names related to the MIL programme to show affiliation. Another student who also chose a name with no apparent resemblance to her physical world identity explained that it was a name she also used in other Internet services, and that part of it in fact was one of her nicknames *(MIL08 student E)*, and this was also the case for one of the MIL10 students:

The name *"Savage"* has followed me as user name for years, and so of course this should also be my name in SL…The surname *"Seaside"* was chosen…well, because…it fits well with Savage…it resonates well ;) Student 10 C.

de Zwart, Collins and Lindsay investigated Second Life users and found *"many examples of residents whose name match their inworld interests and activities as indicated by inworld group membership." (de Zwart, Collins & Lindsay, 2008; 3)*. While showing affiliation and interests through avatar naming may be a conscious choice for some Second Life users, the authors speculate that this is not always the case:

In Second Life, the most salient signals are resident name and avatar. The user characteristics and attitudes that a resident name points to may be obvious … however, in most cases, the relationship between the signal and the user characteristics and attitudes signaled is less obvious to the onlooker; the relationship may not even be apparent to the user for … resident and avatar attributes may represent projection of the user's unconscious self. *(de Zwart, Collins and Lindsay, 2008, p. 3)*

As de Zwart et al suggest, even though the majority of the MIL students' names had no apparent resemblance to their physical world names, they did in fact relate to aspects of the students' lives in the physical world, however contrary to statement above, the students seemed to be very conscious about their choices.

What the names revealed about identities

It should be noted that MIL students signed up for Second Life with a specific, professional use in mind, and this may be different for users who sign up for social, roleplay or other reasons. A survey based on 172 respondents among students enrolled in Second Life, showed that 43% chose avatar names that were identical with their physical world names *(Conrad, Neale and Charles, 2010)*, whereas only 14% of the MIL students chose names that corresponded with their physical world names. In the same study the authors found that 32.6% chose names different from the physical world, and despite lack of explanation for name choosing in the survey, they hypothesise:

Although the majority of students surveyed chose names for their avatars identical or related to their own names, nearly a third chose names apparently unrelated, as if conscious of the difference between their own subjectivity and that of the avatar, and therefore stressing the distance between these subjectivities as a barrier against the melding or confusion of these senses of self. *(Conrad, Neale and Charles, 2010; 7)*

The data from the study of the MIL programme confirm Conrad et al's observation that students are aware of the distance and sometimes even discrepancy between their physical world identities and their avatars. Nonetheless, the students' conscious choices of including some sort of resemblance or relevance with between their avatar names and their physical world names, and the sometimes very personal nature of the derivation of the names, indicate that although the names are not their physical world names, they are chosen in order to establish a close relation to their avatars. Furthermore, the use of names that, although are not their physical world names, are those of pre-existing online *(though not necessarily virtual world)* identities, also indicates a desire to establish an authentic inworld identity. Conversely, participants who do choose to use their physical world names often do so out of convenience, or due to a mistrust of the inauthenticity of identities created within the virtual world rather than a desire to create a close connection with their avatar.

These factors all indicate that interpreting the choice of a name is more complicated than a simple statement that *"same virtual world and physical world names equals close connection to avatar; different names equals distance from avatar"*.

It should also be noted that Conrad et al's statement that differences between the learners' virtual world and physical world names is indicative of the desire to maintain a separation between the virtual and physical world identities does not translate necessarily as a desire to maintain a distance between the self and the avatar. It could be that the participant identifies closely with both as aspects *(but distinct and separate aspects)* of the self *(as in Bennetsen's description of immersionists above)*.

Incorporating the study of naming into the introductory course

As can be seen in the discussion in the preceding section, there are no simple correspondences that can be determined from the choice of an avatar name being similar or dissimilar to the physical worldname. The key role that the avatars' name plays in signalling identity does mean, however, that learners need to be supported in their selection of a name. Part of this requires learners to be aware of the following:

- Participants in virtual worlds vary as to whether they are disclosurist or not. Some do not see entirely virtual relationships as inauthentic. Others do. Seeing either approach as an attempt to hide or to stalk is *(probably)* inappropriate, but arises out of an augmentationist or immersionist stance. Either choosing to use your physical world name or to create a new one is legitimate but will probably signal to other users your position on disclosurism.
- Forming a close attachment to your avatar, and feeling that it represents an aspect of you within the virtual world, will enhance your degree of engagement in that world and enable you to experience it more fully. Choosing a name that has a meaning for you, or is already an existing online identity, will facilitate this process.
- Be aware of the significance of the names you choose, and research these meanings *(as in the Truelove and Hibbert induction)* to avoid signalling something inappropriate, or counter to what you intend, including how they may translate to another culture or language.
- Choose a name that is pronounceable and does not include abbreviations and numbers *(a conclusion drawn from research omitted from this paper for reasons of space, but included here for completeness)*.

As with the Truelove and Hibbert experience, these can only be effectively discussed and articulated by students once they have some experience inworld. Test user avatars will therefore be given so that students can complete the basic introductory course, and then these discussions will take place at the beginning of the intermediate course, once learners are familiar enough with the environment and have a preliminary understanding of the role identity can play within it. It is hoped that through this process learners will be more prepared for their learning within the virtual world.

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Leaving the Lindens: Teaching in Virtual Worlds of Other Providers

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Abstract

With the maturity of the OpenSim architecture it is now feasible to use OpenSim for (university) assignments where Second Life has been used previously. To evaluate these potential alternatives systematically a framework has been developed that takes into account the intrinsic/extrinsic view on the usage of virtual worlds and further distinguishes between a 'world' and an 'individual' view. This classification defines the four dimensions cost (the extrinsic, individual view), persistence (the extrinsic, world view), immersion (the intrinsic, individual view) and in-world context (the intrinsic, world view

The alternatives to Second Life evaluated against the framework are derived from an experience during the Academic Year 2010/11 at the University of Bedfordshire and include: a dedicated provider similar to Linden Lab; a region that is part of the OSgrid hosted by an external provider; a virtual world driven by the university and decentralised hosting of virtual worlds by students.

We conclude that the alternatives are comparable to Second Life in respect to the extrinsic view but not so (yet) from the intrinsic perspective. The specifics of the assignment task need to be considered, in particular the relevance of immersion and in-world context necessary to make the assignment successful.

Introduction

In 2007 the University of Bedfordshire began to utilize Second Life in various teaching and research projects. These projects included a *(final year, undergraduate)* class in the LSL *(Linden Scripting Language)* and classes on Project Management *(both undergraduate and postgraduate)* where students were asked to apply the PRINCE2® Project Management methodology to build an educational showcase on the University of Bedfordshire's Second Life island. The general setup of this latter assignment, in particular the difficulty in dealing with large student numbers have been discussed in *(Conrad et. al, 2009)*. The added value of using Second Life in enhancing the acquisition of Project Management skills is presented in *(Conrad, 2011)* within the context of situated learning *(Herrington and Oliver, 2000)*.

Issues with Linden Lab *(http:///lindenlab.com)*, the provider of Second Life, concerning the ownership of the University island made it virtually impossible, to utilise Second Life for the Academic Year 2010/11. It was therefore decided, at very short notice, to seek alternative solutions without compromising the delivery of these classes. Two providers have been trialed, namely Dreamland Metaverse *(http://www.3dmetaverse.com)* a company that offers regions within the OSgrid *(http://www.OSgrid.org)* infrastructure, and ReactionGrid Inc. *(http://www.reactiongrid.com)* with their own dedicated grid infrastructure. Both worlds are based on the OpenSim *(http://opensimulator.org)* technology which aims to be compatible with Second Life clients and provides a similar 'look and feel' as Second Life in-world.

We also include in our discussion two other solutions that have been considered for our university assignments but not implemented. These are the hosting of a virtual world on a university server and a fully decentralised solution where each student is able to host their own virtual word on a memory stick or on their laptop. This latter approach became feasible with a software distribution *"sim-on-a-stick"* that conveniently packs the necessary software in an easy to install zip file *(http://simonastick.com)*.

Lastly we include in our discussion the solution of not using a virtual world at all for the assignment. Indeed this happened in one of our case studies.

In the following we first outline the case studies to clarify the demands the assignments posed on the virtual world. Then we introduce the six solutions: Second Life, a dedicated provider, OSgrid integrated, institutional hosted, student hosted and 'getting on without'. These will be evaluated against four dimensions of virtual worlds considered relevant to our case studies.

The four dimensions naturally follow a classification in intrinsic/extrinsic view and from distinguishing between an individual perspective and the world perspective. These are persistence, cost, immersion and context. They will be discussed in detail later following the case studies.

Case Studies

This paper derives from three assignments, delivered at the University of Bedfordshire with slight variations since 2007. In the previous years Second Life has been used. In the following we provide a quick overview of the nature of these assignments and the respective role played by the virtual world.

Case Study 1: Event Oriented Programming.

This is a five weeks course where the Linden Scripting Language *(LSL)* was introduced to underpin the understanding of Event Driven Programming *(Ferg, 2006)*. Weekly lectures consisted of the theoretical concepts plus material adapted from the Second Life LSL wiki. In the practical sessions the students wrote scripts with simple functionality. These were deployed in-world and tested by the students' avatars. Typical examples include objects that change colour or produce messages when touched. The implementation of object-to-object interaction explores the various uses of communication channels. The provider used for the course was Dreamland Metaverse. The reason for choosing this provider was based on the recommendation of a chance encounter while casually visiting the OSgrid. Not all LSL functionality known to work within Second Life however is yet implemented within the OSgrid. Because of the nature of the assignments these differences were irrelevant in our case study.

Case Study 2: Project Management *(Postgraduate)*

This is a twelve weeks course, delivered at Postgraduate level, on Project Management. It runs every spring and the students are required to build an educational showcase as part of a PRINCE2® managed project. For details about the general setup of the assignment we refer to Conrad, et al *(2009)*. The pedagogic underpinning that contextualises the assignment within the situated learning approach *(Herrington and Oliver, 2000)* is evaluated in *(Conrad, 2011)*. The decision to use ReactionGrid as the provider was made when the author was approached by an 'evangelist' of this company. Changes to the assignment in the different environment were necessary. The absence of an in-world economy led to a redesign of the 'cost management' and 'procurement' aspects of the assignment. Also students were encouraged to look for example showcases within Second Life while building on the ReactionGrid island.

Case Study 3: Project Management *(Undergraduate)*

A very similar assignment was also used for the undergraduate course. The duration stretches over a period of 24 weeks starting in September. Due to the issues with Linden Lab no university region was available in September 2010 and the assignment was modified by taking out the 'showcase' part and replacing it by a rather unspecific requirement to use web 2.0 technology for the PRINCE2® project. This case study will serve in the following as an example for the 'getting on without it' solution.

Dimensions for the Evaluation of Virtual Worlds

From the issues described and encountered with the case studies we propose four dimensions against which virtual worlds may be evaluated. We distinguish between dimensions extrinsic to the virtual world that

relate to 'real life' features and those that are intrinsic: they are informed by the in-world experience of the avatar. The two extrinsic dimensions are persistence *(how long the virtual environment lasts)* and cost *(measuring the effort needed to participate within the virtual world – including monetary cost as well as time and expertise needed)*.

The two intrinsic dimensions are immersion *(the perception of self when operating in the virtual world)* and context *(conflicts and synergies perceived in relation to other content within the virtual world)*.

We may also group the dimensions according to an 'individual perspective' – the individual that perceives the virtual world as an avatar *(immersion)* or as a real person *(cost)* – and a 'world perspective' – the virtual world persists in the real world and has an in-world context. Table 1 summarizes the relationships between the four dimensions. We discuss these four dimensions in more detail later in this paper.

Table 1 The four dimensions in context

	Intrinsic	Extrinsic
Individual	Immersion	Cost
World	Context	Persistence

Furthermore, within these four dimensions we evaluate six solutions of virtual world setup derived from the case study experience. These are:

- Mainstream provider *(Second Life)*. The well established solution that has been used until June 2011.
- Dedicated provider *(other than Second Life)*. This refers to a virtual world that only exists within the context of the provider, similar to Second Life where all places of Second Life are *(eventually)* provided as part of Linden Lab's infrastructure. While the region is not "stand alone", an avatar that has been created for the university island would only be able to visit places hosted by the same provider *(in our case ReactionGrid)*. This solution has been used for the postgraduate class on Project Management *(Case Study 2)*.
- OSgrid provider. The OSgrid is an architecture that allows severa independent OpenSim providers to connect their worlds. For implementation details please refer to the Hypergrid entry on the OpenSim wiki: http://opensimulator.org/wiki/Hypergrid. Avatars are created on the OSgrid website and can freely visit places run by any of the providers. This solution has been used for the LSL assignment *(Case Study 1)*. The OpenSim driven region was provided by 3dMetaverse.
- Institutional Virtual World host. The OpenSim architecture may be set up and run by the institution, in our case the University of Bedfordshire. This solution has been considered but not implemented, mainly because it was not obvious that the necessary infrastructure was available at such short notice.
- Students host their own virtual world. The Sim-on-a-stick distribution *(http://simonastick.com)* allows hosting a virtual world on a memory stick *(or on a laptop)*. We considered this solution for the LSL assignment *(Case Study 1)*. The unpredictability of how students would be able to set up their own virtual world on their various architectures and how much time this would take was seen as the main reason to trial the OSgrid instead.
- Getting on without a virtual world. This solution has been used for the undergraduate class on Project Management *(Case Study 3)*.

The list above does not aim to show a complete picture of the possible solutions but rather gives a list of those solutions actively considered to meet the needs of the case studies. Other solutions *(for instance to run a 'university hosted' stand-alone virtual world based on a cloud service provider)* that have elements of some of the above may provide a good compromise or even become the main-stream approach in a couple of years' time. Indeed it should be emphasized that both of our providers *(ReactionGrid, 3dMetaverse)* as well as others that are not mentioned in this paper are able to provide a tailored arrangement that might be different from any of these listed above.

In the following we discuss the six solutions in more detail by evaluating them against the four dimensions. We start with the two extrinsic dimensions, persistence *(the world view)* and cost *(the individual view)*.

Persistence
(extrinsic, world perspective)

A virtual world like any software exists within a physical context that may or may not be available. How long will the virtual world last? Assignments will be conducted over a period of time and the student work needs then to be available for reporting issues *(marking and external examining)*. Student work of previous years may be required to serve as examples for the students of the current year.

Mainstream provider (Second Life)

Two years ago Rupert Neate *(2009)* predicted in the Telegraph that *"Second Life's span is virtually over [...]"*. Many similar statements can be found by casually searching the world wide web. However today *(in August 2011)* Second Life still exists. It might be argued that the still large number of residents who have assets *(be they tangible such as virtual dwellings or clothes or be they intangible such as relationships)* create enough vested interest to keep Second Life running for some time in the future.

Dedicated provider

Our chosen provider offers the possibility to backup the whole region as a .oar file. It could then be run on a different provider's environment when necessary which makes the persistence of the region somewhat independent from the provider itself.

OSgrid Provider

Similar as with the dedicated provider .oar files can be used as backups of the region. Even more so, given that the OSgrid is maintained by a number of different companies or individuals a switch from one provider to another is possible while still remaining within the OSgrid context.

Institutional Virtual World host

Any issues that might come up with the persistence of the virtual world process can be resolved within the institution.

Students host their own Virtual World

The stability and persistence as well as the necessity to make backups is delegated to the student. The accidental or deliberate unavailability of a region – for instance of concern when marking student work – can be addressed via existing university procedures about lost work.

Getting on without it

Depending on the type of assignment, data persistence is an issue here as well. If the learning outcome requires to produce collaborative work within a group of students – as in the Project Management of Case Studies 2 and 3 – the work must be located somewhere and there must be safeguards in place to deal with a situation when this work is lost due to the negligence of an individual or issues with the university's technical infrastructure.

Cost
(extrinsic, individual perspective)

In choosing an external provider there are typically *(and in both Case Study 1 and 2)* setup fees and monthly costs; other costs however are the amount of time and effort of individuals that need to be accounted for when setting up the virtual world. This becomes more complex considering the particular characteristics of educational institutions. Some work invested may be considered part of scholarly activity while other tasks are routine and might be performed either by technical support staff *(who possibly have no interest in the usage of the virtual world)* or by the academics themselves, taking up valuable time from other duties.

Mainstream Provider (Second Life)

This solution was the most costly concerning setup and monthly fee. Linden Lab's decision to abandon the discount for educational institutions will not help to improve the situation. Because of the abundance of tutorials and other online help the cost and effort required to be put in by staff is low compared to other solutions. There is also a *(still large)* in-world academic community that is able to provide support, for instance with sophisticated and tailored tools.

Dedicated Provider

The costs encountered for the assignment were very competitive concerning both setup costs and monthly fees. Because of the similarity to Second Life the costs on building and maintaining the virtual world is comparable to the effort needed within Second Life. The provider also offers consultancy if this is considered necessary (which increases the monetary costs but decreases the cost of time and effort).

OSgrid Provider

Setup and monthly fees compared well to those of our dedicated provider. Also, consultancy is offered as an extra. However for the OSgrid, due to its open structure it is also possible to source developers or builders from other providers.

Institutional Virtual World host

Given that the OpenSim standard is free there are no direct monetary costs. For many institutions this might be the preferred solution as internal costs such as server time, staff time both technical and academic are often not perceived as 'costs' (the staff costs are hidden within the fixed monthly salaries and a server may be available anyway for other tasks).

In our case this solution was not followed up. As there was no previous experience on setting up an OpenSim based virtual world and the technology doesn't yet seem sufficiently well documented and mature enough that an easy install could be expected.

Students host their own Virtual World

Concerning costs this is a tempting solution. There are no setup costs or usage fees. Time to install software will be spent by students themselves. However – as with many cost effective solutions – there may be ethical conflicts with this approach and its long-term consequences. While Computer Science students might indeed benefit from the experience of setting up a virtual world using their own devices students of other disciplines might find the point of acquiring the necessary knowledge questionable. In the long term this approach might have a negative impact on the reputation of the course.

Still, with ongoing maturity of the technology there may be merit in this solution. For instance we typically expect students of any discipline to have or acquire knowledge of certain standard software (e.g. Microsoft Office). In the future virtual worlds may have a similar status.

Getting on without it

This is not necessarily the cheapest solution. The lack of use of certain types of technology within a course may well be a reason for a prospective student to choose a competitor institution. The role of virtual worlds in particular is however unclear. During the Second Life 'hype' it was perceived as somewhat obvious (as with most hypes) that virtual worlds will play a significant part in education, see for instance Virtual World Watch (2010) for an overview of past and current projects in the UK. We believe that despite the end of this hype the usage of virtual world technology within a curriculum might still provide a certain market advantage.

Immersion
(intrinsic, individual perspective)

Virtual Worlds provide the opportunity of immersion (Cunningham, 2007), to become part of the virtual world, to lead a 'second life' in its most literal meaning. Indeed this distinguishes virtual worlds from other social and collaborative places such as chat rooms or discussion forums. Questions of identity may raise the debate about the way such a virtual world can or should be separated from the real life experience (Peachy and Childs, 2011). In a university assignment it is questionable what role immersion has to play: student work is assessed in real life with real grades.

Due to the ad hoc approach in deploying our solutions there is no systematic collection of data on how our students felt about the degree of immersion they encountered. Therefore the argument below can only be based on anecdotal observation. Still we hope that it gives some reasonable insight.

Main stream provider (Second Life)

In our experience Second Life offers the highest degree of immersion compared to the other solutions. The whole concept and marketing strategy appears to be based around the idea of escaping from the 'real world' and the various amenities including shops and party spaces underline this. While it is a minor aspect for our LSL course (Case Study 1) where the focus is on the technical understanding of a programming paradigm, immersion is more central for the assignment of Project Management (Case Study 2 & 3): the project task must feel 'real' to make the assignment a success.

Dedicated provider

Immersion did not seem to have materialized. While it is indeed possible to teleport to other regions of our provider there is no evidence that this was tried or has happened. Indeed, given the perceived or real absence of 'recreational facilities' or actual other avatars on these other regions no incentive is given to explore this world to a wider extent than necessary for the assignment.

OSgrid provider

The configuration of the OSgrid environment allows the possibility to teleport to various recreational places including those not hosted by our provider. Promoted as an open source alternative to Second Life many amenities are mirrored within the OSgrid environment. This includes a place to party or to hunt for clothes. During Case Study 1 some students seemed to have used these opportunities. It was our understanding that the OSgrid at least was more perceived as a 'world' than the region provided by the dedicated provider in Case Study 2.

Institutional Virtual World host

Clearly the degree of immersion will depend on how the virtual world is set up. It can easily be envisaged (and might even become the norm in the distant future) that 'virtual space' becomes normal within a university similar to 'real' spaces: library, lecture theatres, student union or prayer rooms. Immersion into that virtual world may become part of normal student life (and it may be open to debate if this behaviour should still be termed as immersion or rather an 'augmentation' of student life).

Students host their own Virtual World

Many virtual worlds (one for each student) would co-exist independently from each other. It would depend very much on the individual setup how much 'immersion' would be possible.

Getting on without it

If there is no virtual world immersion may happen in the real world for instance via role play. How necessary or desirable is an immersive experience anyway? In the context of the LSL assignment (Case Study 1) where the focus is on a technical understanding, immersion is a minor aspect. For the project management however a higher degree of immersion is desirable: students role play a 'professional' project team following a methodology to achieve a project goal. The better the opportunity is to 'immerse' into that role the more valuable the assignment would be.

Context
(intrinsic, world perspective)

While educational institutions are often keen to see their courses in the context of certain aspects of the wider society *('industry relevant', 'vocational', 'impact' are words that come into mind here)* other aspects of this very same society they would rather protect their students from: filter software is deployed within colleges or universities to restrict access to Internet sites containing so called 'adult' content and disciplinary action may follow attempts by staff or students to circumvent these filters.

For the sake of this discussion we distinguish between 'positive' and 'negative' context within a virtual world. Positive context might be in the form of tutorials, scripts or recreational places to stimulate immersion. Negative context may come from 'adult' rated themes: for instance places that display sexually explicit material, feature intense violence or endorse racism.

Main stream provider (Second Life)

Linden Lab's system to distinguish between regions with general, moderate and adult content has reached a certain level of maturity. Although it may be debatable how effective this control is in practice, it provides at least a basic means to classify 'adult' sites. This classification can then be used within a general policy on appropriate behaviour (e.g. avatars that can be identified as students of the university must not visit regions flagged as 'adult'). Positive context is still abundantly present in the form of tutorials, support from other residents and other resources in-world.

Dedicated provider

The context we experienced can be best described as 'neutral'. While the relationship between the provider and us was good and productive there was no perceived interaction with other residents: there was no 'community' feeling. If at all, community interaction happens outside the virtual world through means of social media such as twitter, youtube or facebook. Indeed students were encouraged to seek examples from within Second Life (i.e. to use the Second Life 'positive' context) and then to build their showcase onto our provider's region.

OSgrid provider

The OSgrid – as a result of its distributed and appraently unregulated structure – is able to carry contents of any type, including adult themed areas. Indeed Mathers *(2011)* writes in his blog *"We are building a new BDSM community on OSgrid and your are welcome to join [...]"*. How this or other attempts will materialize is difficult to forsee. The situation is similar with positive context: many places offer freebies or recreational activities. Still much of the contents of the OSgrid seems to be experimental or in an early stage with low traffic numbers.

The 'negative context' might well become a lesser issue due to how virtual worlds in general and the OSgrid in particular will be perceived by society. Similarly to the current situation where the abundance of 'adult' content on the World Wide Web doesn't deter universities from going online with their own web sites, a similar perception might occur within the OSgrid: where content that is hosted with one provider will not be seen as related to content hosted by another provider although both are connected through the same grid.

Institutional Virtual World host

The context can be designed and monitored similarly to any other *(real world)* student service. Behaviour can be controlled as part of the overall student conduct measures. Therefore potential negatve context can be dealt with appropriatly. Positive context may be provided as part of a university strategy.

Students host their own Virtual World

The sim-on-a-stick solution puts the responsibility for any type of content solely on the student.

Getting on without it

Any course project that requires students to leave the university boundaries – for instance in the context of situated learning as defined by Herrington and Oliver *(2000)* and therefore utilising real world positive context will face the question on how these students can and should be protected from undesirable encounters *(negative context)*. Indeed an inherent feature of virtual worlds is that the context of the 'world' is more controllable than the real world *(for instance a virtual world can be switched off or pre-populated with supportive content)*.

Conclusion

While only a couple of years ago the hype made the term 'Virtual World' become almost a synonym for 'Second Life', there are now more and more alternatives available. In particular OpenSim based solutions are in direct competition with Linden Lab's Second Life due to the OpenSim history and hence technical similarity. OpenSim based solutions are embraced by both dedicated providers with their own infrastructure and as part of the OSgrid. It is also possible to install and run an OpenSim based virtual world as an institution or even as an individual.

The author of this paper made the switch away from Second Life out of necessity due to a particular experience where poor customer support from Linden Lab made it impossible to continue with them as a provider.

It is tempting to generalise from this one experience and herald the demise of Second Life; however this must be seen in perspective. Weak customer support is only one aspect of the virtual world experience, and even this experience is only a snapshot of a given period of time and may change or may have changed already driven by Linden Lab's very own commercial interests. Similarly other providers might face customer support problems when they become successful and have to scale up their business.

Nevertheless the switch to an alternative virtual world provider presented an opportunity to assess the feasibility of these for the purpose of a university assignment and we aimed to explore these in a systematic way.

We took both an intrinsic and an extrinsic view on virtual worlds and further refined this by distinguishing between the individual and the world's perspective. This framework then defines the four dimensions persistence *(extrinsic, world)*, cost *(extrinsic, individual)*, immersion *(intrinsic, individual)* and context *(intrinsic, world)*. Within these four dimensions we evaluated – based on three case studies – the solutions: Second Life, various OpenSim based solutions and 'getting on without it'.

There is no 'best' solution. All approaches have advantages and disadvantages and need to be balanced according to the specific needs: the duration of the assignment determines constraints on the level of persistence needed. Cost is determined by available funds and the existing technical knowledge at the instituion. The necessary level of immersion depends on the nature of the assignment *(an LSL class only needs a 'technical' presence in the virtual world while a project management assignment benefits from an immersive experience)*. The benefit from working within a virtual world in a community context is to be balanced against the level of 'risk' an institution allows itself to take that undesirable content may be encountered by the students.

All solutions discussed are viable alternatives to Second Life. Concerning the extrinsic dimensions, cost and persistence, they are comparable or even better. However a loss of immersion due to the lack of in-world context needs to be taken into account when switching away from Second Life. Activities such as our case studies 2 and 3 that benefit from the Second Life in-world context will suffer and measures are necessary to compensate for this loss.

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Simulation in Computer Forensics Teaching: the student experience

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Abstract

The use of simulation in teaching computing is well established, with digital forensic investigation being a subject area where the range of simulation required is both wide and varied demanding a corresponding breadth of fidelity

Each type of simulation can be complex and expensive to set up resulting in students having only limited opportunities to participate and learn from the simulation. For example students' participation in mock trials in the University mock courtroom or in simulations of digital seizure in the University Forensics House require many months planning and co-ordination across Faculties. To enable students to gain more experience, in a cost effective way, simulations are being developed in Second Life to for seizure of digital evidence and to provide opportunities for students to practice as expert witnesses in a virtual courtroom.

Examples of the simulation techniques and of student use are described and include for examples of: simulated seizure of evidence; simulated case investigation; investigation techniques that involve virtual simulation of systems; simulated court appearances (for example as expert witnesses).

Student feedback suggests that simulation is usually highly appreciated by students, but also can induce stress and anxiety in some instances. This paper reviews evidence from students, qualitative and quantitative, and discusses the pros and cons of simulation for both teachers and students.

Simulation in teaching and training

Simulation has been used in many areas of educational and training. In the twentieth century increasing complex technology was used to create higher fidelity simulations. In the area of pilot training, where the underlying activity is always dangerous, flight simulation began within a few decades of the first manned flights, with, for example, the Link simulators providing an increasingly complex series of flight control simulators *(L-3 Communications, 2009)*.

Simulation has also been used in training social skills. For example training a candidate *(or interviewer)* involves simulating an interview and then reviewing recordings of the interview after the event. A similar approach is used in systems analysis and design, where participants playing the key business roles are interviewed by teams of students in order to gather data about system requirements *(Zowghi & Paryani, 2003)*.

There are a number of areas of digital forensics teaching that suit a simulation approach. In practice most digital forensics units make use of a problem solving pedagogy, and often involve students working on a case. Digital forensics involves a three stage process, beginning with the acquisition of digital evidence *(sometimes referred to as seizure)*, the analysis of digital evidence *(often surprisingly complex due to the huge number of files found in all modern operating systems)*, and the presentation of evidence to laymen *(for example to a lay jury)*.

Digital Forensics Simulations

Seizure

Seizure is the process of seizing the information system from a crime scene or suspect. As with any forensic evidence it is vitally important that evidence is not changed by virtue of the process by which it is obtained. Conventional forensics scientists will wear sealed clothing in order to minimise contamination of a crime scene, and will ensure that each item of evidence is collected in a way that prevents transfer of *(e.g. fingerprints or DNA)* from the forensics officer to the evidence.

Digital evidence can be somewhat different. A running computing will usually be running processes all the time. The action of shutting down a computer operating system will involve many operations, data being written to log files, files being closed and deleted, updated modification dates etc. It therefore becomes very difficult to demonstrate that intentional changes have not occurred to a piece of digital evidence. Most police services around the world have issued guidelines about the methods that should be used to secure digital evidence. In the past failure to secure digital evidence has cast doubt on the validity of the evidence, and its validity has been open to question. For example in the Julie Amero case *(Losavioet al 2008)* highlighted the difficulties the legal profession has with digital forensic evidence when a high school teacher was accused of showing her students pornography. The case revolved around the use of unwanted 'pop up' images, and whether these were triggered by the accused or whether the images were due to malware.

In the UK the Association of Chief Police Officers provides a document that advises on a legally and forensically safe digital seizure procedure *(ACPO, 2007)*. Unfortunately general guidelines may not be useful due to the possibility that a computer may be running one of a variety of operating systems and may have one of a variety of disk encryption systems installed. The traditional process of disconnecting the power supply and removing hard drives is less appropriate when that might simply capture highly encrypted data that is *(for all intents and purposes)* unrecoverable without the co-operation of the suspect. In addition changes in technology mean that the procedures followed have to continually adapt. Students need to be able to make appropriate judgements about the seizure process to undertake, so that they have the best chance to circumvent any 'anti-forensic' strategy undertaken by a suspect.

Seizure simulations usually involve presenting students with a running computer in an office like environment *(often a staff office or similar)*. Students are then asked to perform a seizure. Such simulations are usually quite engaging for the students but do involve quite a lot of preparation, and often involve one student acting as an 'avatar' for a whole class *(Fig 1)*.



Figure 1

Seizure Scenario demonstrating team based work: one student performs the majority of the hands-on work whilst others direct, discuss, comment and record the process.

After seizure and imaging students will end up with a disk image. This image is a bit copy of the computer's hard drive, and it is this which they preserve and analyse, looking for evidence. Constructing meaningful cases is often one of the most difficult parts of teaching digital forensics, since it is necessary to create a 'trail' of events on the hard drive which are consistent with the criminal and innocent behaviour of the suspect. Virtual computer systems are used to construct these cases, and may also be used by analysts to get a 'suspect's eye view' of the system being examined. A range of commercial and freely available tools can be used for virtualisation. However the legal forensic evidence is usually the result of analysis of images using specialist software, widely accepted as legally sound. In this way files and records of interest may be discovered and these will usually form the basis of a digital forensic expert's report.

Court rooms and giving evidence

Giving evidence as an expert witness is something that many forensics experts may be required to do during their career. Expert witnesses usually have to explain the evidence and its meaning to a lay jury. For digital forensics experts the evidence may involve complex and counter intuitive concepts. For example an explanation of why a digital photograph file, appearing on a computer, may never have been actually seen by the user of the computer. The usual process for an expert witness is to write a detailed report *(which must follow certain guidelines, and must not itself break the law)*, and then to be examined and cross-examined by council for defence and prosecution, in court. The basic process of being a witness is straightforward, but can be very intimidating and stressful. Expert witness may be called to a number of different types of court.

During digital forensics courses it is common for students to undergo some form of court room simulation. In the University of Portsmouth a high fidelity simulated *(mock)* court room was opened in February 2010 by the Portsmouth Business School. The mock court room *(Figure 2)* is used by a number of Faculties, and provides a suitably intense experience of court room processes to students.

The court room is really a room with unusual furniture laid out in a particular way, with the illusion enhanced by a few special effects, such as a coat of arms, and a witness box. Never the less the illusion is quite strong, and is enhanced by the formal behaviour of the role playing participants *(judge, council, ushers etc.)*. Equipped with closed circuit television, it is possible to record and review each student's performance.



Figure 2 Mock Court Room *(high fidelity court room simulation)*.

Court room simulations are usually used with students individually, as part of the assessment process, where students are cross examined about their report on evidence of their findings from a simulated investigation. Students often find the experience very intense and even frightening. Part of this is due to the unusual experience of seeing their tutors dressed formally and behaving in an unusual role.

Students are also encouraged to visit the public gallery of the local Crown Court. This gives another perspective on court processes and formality, but can be somewhat hit and miss, as it depends on the cases being heard, and which part of a trial that is seen *(for example hearing evidence is often a fairly brief part of many trials, and expert witnesses are uncommon)*.

Using Second Life as a simulation environment

Second Life seizure simulation

The Second Life seizure simulation is based on student prototypes developed on an undergraduate human computer interaction unit *(HUCID)*. The simulation consists of a location in which a target computer is placed, and a number of actions can be completed. Learning materials are usually located in the same area. The use of student prototypes meant that a number of different locations and styles of delivery can be built *(Fig 3)*.



Figure 3 An example of a virtual seizure simulation environment in Second Life.

Extensions to the prototype involve more complex simulation of the seized computer's behaviour. An incomplete project involves the use of virtual network computing *(VNC)* remote control of a virtual pc running elsewhere *(using the built in VNC server on the virtual machine software QUEM, http://wiki.qemu.org)*, and projecting its screen and behaviour into the virtual world. In this way the behaviour of a wide range of computers could be seen in Second Life.

A second extension will allow the Second Life target computer to be disconnected, opened and to have items removed, for example hard drives for later imaging. If combined with a virtual computer, it would actually be possible to image the virtual pc, and provide the resulting image via a server.

The current Second Life seizure simulation can be accessed at any time by students individually, and is a useful adjunct to running a high fidelity simulation as a class exercise. The environment includes learning material in one bay, a simulation exercise in the second bay, and assessment exercises in the third bay. As a stand-alone environment students can use it at any time with the presence of a tutor being optional *(Crellin & Karatzouni, 2009)*.

Court room simulation

The Second Life court room simulation included a building with all the main components of a court house *(including not only the court itself but witness waiting areas, jury consideration areas etc.)*. Figure 4 shows the court room, with the main features, the bench, jury box, and witness box.



Figure 4 Court Room Simulation in Second Life.

The court room includes a number of animated avatars which simulate some aspects of court procedure, for example a judge, simulated jury members and the accused. Other simulated roles have simple behaviours attached to them, for example an usher who can take a witness into the court room from the waiting area, an 'oathing tool' which allows a witness to swear in, and lawyers who can ask a series of simple general questions. Automated note taking is enabled, so that a transcript of the court case can be reviewed at a later date, or submitted to tutors for feedback. In addition, learning materials on the nature and processes involved in a court are available

within the simulation. These use Second Life techniques such as note cards, and media slide shows to introduce the features of a court in an on-demand mode.

A number of extensions to the court room simulation are proposed including the introduction of an automated guided tour of the court room and related rooms, and more sophisticated scripts for the court room 'role' avatars. This will assist with the difficulties caused by the court room being quite cluttered with objects, which can make navigation through the spaces difficult, particularly for novice users.

Student feedback and response

Unit feedback from two cohorts of the digital forensics unit have been collected *(Table 1)*. The teaching content of the two years *(Year01 and Year 02)* was similar with no major changes between the two years. The digital forensics unit was one of the more popular units studied in the first academic year, but was much less popular in the second year. In both years the amount of face to face simulation was constant *(slightly increasing in the second year)*. In the second year more exposure was given to the Second Life simulation.

The two cohorts were however markedly different. The first cohort included several students with law enforcement experience, and systems administration experience, whilst most of the students in the second cohort came from other courses, or from less relevant working experience. Students in the first cohort were much more likely to spend additional time on self directed work *(as evidenced by out of class lab attendance)*. Qualitative comments from the two cohorts were also quite different. In year01 the comments about the simulation exercises were almost ecstatic, in year02 very few students commented on the simulation exercises, but often commented on the difficulty of the material.

The data does not allow any definitive conclusions, however some patterns do seem to be indicated. Although simulation may be seen as a way of increasing engagement

Year of Delivery	Content	Interesting	Delivery	Enjoyed
Year 01	4.33	4.89	4.22	4.78
Year 02	4.25	4.13	3.75	4.13

Table 1 Unit feedback averages for the Digital Forensics Units.

with students, the effect is likely to be more complicated. Students with higher levels of engagement with the subject matter seem to find using virtual worlds for the simulations enhances the activity. Those with less subject matter engagement seem to find that simulation simply increases the apparent complexity of the material, rather than illuminating and enhancing.

Teacher feedback and response

One of the problems with conventional simulation is that it usually requires a great deal of setting up for each run of the simulation. This makes it difficult to run a simulation for each individual student. For example it usually takes at least three hours of staff time to set up when a court room simulation is run with individual students giving evidence as part of their assessment. Second Life based simulations can however be 'left in place' or packaged, so that they are always available. Running the face to face court room simulation *(with about 15 minutes of cross examination for each student)* then takes approximately five to eight hours of staff time, and involves four members of staff. A Second Life simulation can be run by a student on their own, using the automated role playing avatars. A student is able then to repeat the exercise as many times as they wish, and can also record the session for future reference, or for formative feedback.

Some aspects of the tasks involved in digital forensics have proved very difficult to simulate effectively in Second Life. For example a real cross examination does not involve a fixed sequence of questions, but rather involves a dialogue between the lawyers and witness, as the lawyers attempt to extract the real meaning and significance of the evidence.

Conclusion

Simulation can operate at different levels of fidelity. High fidelity simulation tends to involve more work each time the simulation is run than a lower fidelity digital simulation. The extent that simulations at various levels of fidelity increase engagement is complex. Different groups of students respond to the simulation exercises in different ways, in part based on their motivation for undertaking the course and on their previous work experience. Ease of use of the simulation *(for both teacher and learner)* seems important. Second Life has the advantage that it is relatively easy to use with little initial preparation, almost at a whim. However it can be frustrating for novice users who experience difficulty moving around in buildings, between furniture and comprehending the interface.

Future development and enrichment of the Second Life simulations will enable both further evaluation of the relationship between individual students engagement with the subject and the different forms of simulation.

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Setting Up a Virtual World for Teaching English Language: Why Open Sim?

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Abstract

Following an investigation of language learning in Second Life (Derrington & Homewood, 2008) the Homewood Project was set up to create a Virtual World (VW) for learning English as a second language (ESL). Open Sim software was used for the server and students were advised to use the Hippo Viewer to enter the world. This paper reviews the reasons for the choices made and some of the technical problems encountered and solved in setting up the ELIP~Homewood world.

The choice of language learning resources created is discussed briefly in terms of current theory concerning second language acquisition and pedagogy. The creation of these resources and the implications of building and scripting them in software that was inherently less stable but perhaps more controllable than Second Life (SL), the relative benefits of language learning in small and in open environments, the relative financial costs and the steep technical learning curve must all be taken into account in making such a choice. This paper focuses on the technical aspects and challenges in implementing a VW on a computer at home and using it with international students for research into second language acquisition.

ELIP~Homewood Virtual World

ELIP~Homewood is a virtual world created for language learning and research. There is a website *(ELIP, 2010)* where users can create an account and find instructions *(including two YouTube videos)* telling them how to create an account, download and install the viewer software, add the ELIP~Homewood grid and log in. Once inside the world they can follow further instructions to personalise their avatars, choose clothes, activate voice and explore. As they wander through the world *(there are twenty 'sims', regions or islands)* they will find places to meet, hang out and chat with other students; an English pub with a bar and dance-floor and a pub garden with 'English Cream Teas' including scones and cakes; a beach with sailing boats and rafts, sunshades, sandcastles and a camp fire. There is a supermarket complete with shopping trolleys and checkouts. The aisles, shelves and gondolas, fridges and freezers are crammed with goods all labelled in English. There are other shops including a post office, hair salon, kitchen design store, and clothes, furniture and china shops. There are the usual lakes, parks and gardens which abound in virtual worlds, an open-topped, double-decker, sightseeing bus and hot air balloons also for touring and sightseeing.

Figure 1 To personalise their avatar, choose clothes...



On one island, students can be given their own plot of land to build a house. There is also a huge *(full sim)* sandbox with 'lessons in a box' where they can follow instructions *(in English)* with screenshots and diagrams to learn how to build houses, furniture, flowers and trees and some students have already become quite accomplished. Two students also have shops where they display objects they have made which can be 'bought' by others. They swap objects they have made and use English to collaborate, explain things and help each other.

In the 'Grammar Dungeon' beneath the castle, those students who wish to torture themselves can look up rules of grammar with examples displayed on huge posters on the wall, and changed by using holodeck software which, at the click of a button can change all the posters to show different grammatical rules. There are also various scenarios dotted around the islands with scripts, and example sound-files which students can use to act out scenes and roleplay. These playlets are the very same that they have encountered previously in their lessons on Skype.

This virtual world has been designed for an international group of students who usually use Skype and other internet resources to learn and practise English language and conversation. Many of the language learning resources on the Homewood Islands can be compared to, or are even designed to mirror similar activities these students use to study English in Skype or elsewhere. However others would be impossible or difficult to replicate outside a virtual world. It is hoped that this world will provide opportunities to study these students' language acquisition, their autonomy, motivation, enjoyment and success in language learning and to gain some insight into the possible use and the worth of virtual worlds in second language acquisition.

Not Second Life

Having been involved in teaching in SL since 2007, my first thought was to buy land there for the ELIP project when it began early in 2010. Investigation showed that even with the half-price tariffs then *(but no longer)* on offer to educational institutions this was beyond my means. Indeed it appears that this is the also now the case for other educators and researchers some of whom are moving to OpenSim and Osgrid. *(Rogate 2011)*

So, I gratefully accepted the offer of six free regions on an OpenSim grid hosted by an American academic. I learned first to use other viewer software besides the SL viewer provided by Lindenlabs; Hippo , Kirsten, Radegast, Imprudence etc and to set the viewer so that I could log into other worlds besides SL. Hippo seemed to be the best combination of simplicity of set up including adding and changing grids *(for visiting different worlds)* and effectiveness on a low-spec computer which is why it is recommended to new users of ELIP~Homewood. This was a brave new world with nothing in it and I did not then know about Second Inventory and several other methods of transferring objects from one world to another. There were no shops! So everything from avatars and clothes to buildings and plants was built from scratch.

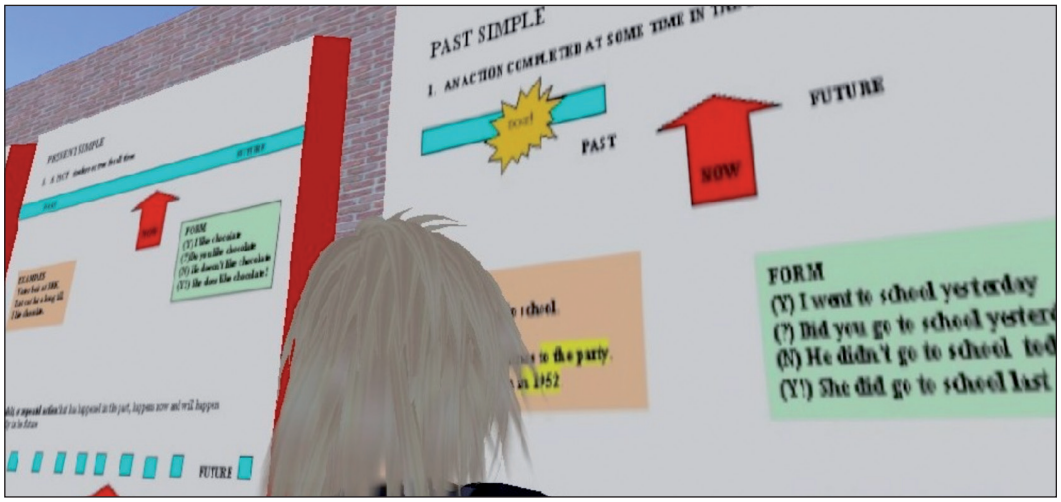


Figure 2

In the 'Grammar dungeon'

There was a major setback in June 2010. After a crash caused by a power failure in California, it unfortunately transpired that supposedly automated backups had not actually been taking place. The world was closed for a few weeks and restoration promised, but eventually it was admitted that the most recent backup was months old and all changes made since then had been lost. On the Homewood Islands that comprised many, many hours of intricate building work including a supermarket comprising over 1200 prims *(or building blocks)*. Designed as a resource for acquisition of vocabulary there was a great variety of products for sale, heaps of fruit and vegetables, bottles of wine and shampoo, loaves of bread, cream cakes, chilled and frozen meals. This had taken many hours of painstaking effort, creating each article and applying an appropriate texture; scores of different textures specially created and uploaded. This hiccough was one of the factors in the decision to host the ELIP~Homewood world independently on a home computer and this was accomplished a month later with the help of one of the students in the ELIP group who happened to be a computing undergraduate at Moscow State University.

Technical Issues in Setting Up a Virtual World

The software used for the creation of ELIP~Homewood is Open Sim, the free, open source version of the software used to create the commercial world of SL. There is a MySQL database which holds the content of the world; objects, scripts, textures, avatars etc. This is backed up every night at 9pm. and the backups are stored on a separate partition of the hard disk and from time to time copied onto another computer on a different network. Extra backups can be made, for example after completing an extensive building operation, but since the world seems to be very stable, this is rarely deemed necessary. Currently the backup file each night for the 20 sims is just less than 500Mb; not huge. Even after a year of nightly backups there is plenty of room on the 250Gb partition set aside for this purpose; and if more space was required, the early backups could be deleted.

When setting up a new grid, the database has to be created before installing the Open Sim software and both MySQL and the default SQL-lite are free. ELIP~ Homewood was created with Open Sim version 6.9 which a

Figure 3 Supermarket comprising over 1200prims…



year ago was the latest version. Since it is stable and works well it has not been updated as further versions *(currently 7.1.1)* have been released. Freeswitch is used for Voice. This is a separate program *(as is voice in SL)* and seems less stable than the rest. In view of the origins in Skype of the ELIP group, and the desire to include ELIP members who cannot run a virtual world viewer, Skype is often used for voice rather than Freeswitch, with some students running and using both Skype and a virtual world viewer such as HIPPO and others with less powerful computers following the class in Skype alone. Those in world can take and send snapshots to help or tantalise the rest.

These are the essential programs, necessary for the installation and creation of a grid or virtual world. Additional optional software includes Toad for MySQL, a utility which can be used to manage, copy, and edit the database. Further software is required in order to set up and manage a website for users to create their own accounts. Apache HTTP server, the PHP programming language, and EditPlus were used for this. However, if accounts for a world or grid are only to be made and issued personally and individually, for example to a class of students or a group of researchers, this web presence would be unnecessary. Installation instructions for all this software are available online on the Open Sim wiki at Opensimulator.org and experience has shown that help and advice can be readily obtained from Osgrid residents many of whom run their own Open Sim grids.

Routers and internet access

In order for the virtual world to be accessible to the users logging in, various ports on the router have to be opened for the Open Sim server software, for Freeswitch; and indeed each sim that is added to the world requires its own dedicated open port. Open ports are a security risk as they can be used by hackers to gain access to the system. This is the problematic aspect of hosting a virtual world behind the firewall in an academic institution. Network administrators are very unwilling to open these ports. ELIP~Homewood is set up not at KCL but in my home, using a domestic internet service.

Initially the grid server was set up using a cable modem without an attached wifi router in order to avoid sharing the available bandwidth with any other computer or application and a second ADSL *(via a telephone line)* internet service with a wireless router was used to connect all other computers in the house to the internet. However, so far there are rarely more than 5 or 6 avatars in-world so this policy was relaxed after six months or so and a wifi router was connected to the cable modem so that other computers could also use that internet connection.

A static IP address is required for hosting the virtual world. Since the cable internet very rarely changes its IP address it can be regarded as static, but if for some reason the IP address changes, *(either because the router is deliberately reset or is left off for several hours)* or if a new router is installed this can be a problem requiring the new IP address to be inserted in several places in the Open Sim program before restarting it.

Hardware and bandwidth

The ELIP~Homewood world is hosted on a pc with a windows XP operating system. It is quite a powerful PC, with a Dell Precision T7500 Xeon E5520 CPU and 3Gb RAM. It is not necessary to have a powerful pc to set up and host a world just to try it out and run Open Sim software. However as the number of islands and the content increase, greater processing power and RAM are needed. The most significant factor however is the number of avatars simultaneously logged in. The more avatars there are present within the world, the more RAM, processing power and above all internet bandwidth are needed to prevent lag. 'Lag' is the name given to the turgid working of a world where an avatar may become frozen, sluggish, start moving erratically *(or more likely continue to move and be unable to stop)* or crash. In the worst cases a whole sim, or even grid can crash requiring the server to be restarted and all the users to relog. This actually happens quite frequently in SL when for some reason too many avatars gather in one place. It happens less frequently in Open Sim worlds where use is both less random and less intense.

For each avatar logged in, 100kb/sec bandwidth is required by the server; double that if voice is used. Internet Service Providers *(ISPs)* typically support their domestic customers' download speed. They rarely mention the upload speed which even on a cable connection is generally far less than the download speed *(Ofcom 2011)*. So the limiting factor in hosting a virtual world is generally the upload speed that can be obtained from the ISP.

When ELIP~Homewood was first set up in July 2010 on a home computer using a domestic internet service, the best ADSL service that could be obtained had a maximum upload speed of 0.8mb/s which would severely limit its use. However using a premium 50Mb/s download account from a cable ISP, a 1.6 Mb/s upload speed was achieved. Experiment showed that 15, 16 and even 17 avatars could log in simultaneously, before they were severely affected by lag. Since then BT Infinity has become available giving average upload speeds of 9mb/s *(Ofcom, 2011a; Ofcom, 2011b)* but since this option does not include a fixed IP address *(another necessity if avatars are to log in from outside the immediate network)* and experience has shown that rebooting a modem attached to an ADSL line immediately changes the IP address, cable remains the best option.

Happily Virgin Media have recently changed their policy on cable provision, increasing the upload speed provided to10% of the download speed contracted. This new standard is gradually being introduced across the country and since June this year ELIP Homewood has benefitted. Now with a 50mb/s download contract, 5mb/s upload speeds are obtained theoretically supporting 50 simultaneous logins but I have been unable to arrange for 50 avatars to log in simultaneously to test this! Another ISP, BE, currently offers a static IP address with domestic internet connections and advertises up to 2.5Mb upload speed *(Uswitch, 2011)* which should support over twenty simultaneous log-ins *(without voice)*. The situation is constantly changing as ISP's change and improve their services, but the Virgin cable 50Mb contract with its 5Mb upload speed and in practice almost static IP address appears to be currently the best option open to a domestic user.

So, given a reasonably powerful computer and a top of the range domestic internet connection, it is now possible for an educator or researcher with a little technical know how *(or help)* to set up a viable virtual world at home, which can be accessed by colleagues and students from anywhere in the world. ELIP~Homewood is one such.

Using a Hosted Server

Several businesses provide a hosting service for virtual worlds *(Hypergrid Business (2011)* either as a separate world or attached to a hypergrid like Osgrid. Using such a service can remove some of the technical burden but it also removes control. Stories abound *(Korolov, 2010)* of websites and virtual worlds lost because of hackers and/or backup failures but many businesses and educational establishments seem to buy in both the hosting and also the design of the virtual world environment. This is another option open to a researcher and the cost of such a service varies but generally depends on how the world is to be used; ie how many sims and how many simultaneous logins will be required, since this determines the processing and bandwidth required.

English Language Improvement and Practice; the 'ELIP' group

The ELIP group originated on Skype and is a group of adults from all over the world who study together helping each other to improve and practise speaking and writing in English. Many people use Skype and other similar free text and voice social media for practising and learning English and other languages, looking for native speakers of the target language to chat with, and joining together in groups to practise in voice conferences. The members of the ELIP group are 'serious students' who wanted to avoid the many flirts and idle chatters who they find pervading these online chat rooms. They eschew the use of mobile text abbreviations, and want to avoid lazy or ignorant native speakers who used an uncapitalised i *(sic)*, slang and incorrect spelling and grammar. Skype seems to be unique in allowing text chatters to edit and correct their messages after they are written and sent. ELIP members correct their own and urge each other to correct identified mistakes

in their English. The single native speaker in the group is a qualified ESL teacher who acts as a teacher and facilitator, and when available, helps with queries, corrects mistakes and holds regular conferences where students practice reading and pronunciation by acting out scripted dialogues and revise grammar etc by discussing queries arising from these dialogues.

The different individuals in the group are studying English for a variety of reasons: some just for fun, some to improve career and employment prospects and some as an adjunct to full or part time language study in a 'real life' college or university. Some of them are short term enthusiasts, working for a particular examination for internationally recognised qualifications like IELTS or TOEFL. Over a short period of time these students attend every class they can find and seize every opportunity of practising conversation, preferably with native speakers. They quiz other students about resources to be found on the internet and sometimes study together talking in a Skype conference and accessing the same web based quiz together, comparing and discussing answers. Other members of the group are non-native English teachers, who teach English as a foreign language in colleges and schools in their own countries and want to maintain and improve their level of expertise and fluency. They join in the activities of ELIP sporadically over months and years. And many others just study English for fun. They like to listen to English radio *(a few follow the Archers, a long running BBC radio soap)*, read English books and they also want to chat to others in English; they seek out other like minded individuals who want to join in their regular reading sessions and discussions.

ELIP and Homewood

The ELIP Homewood project is in its early stages, and several students from the ELIP group on Skype have been invited to try it out. They have been trying out the building, scripting and language lessons and a few have started building houses there. Not all of the ELIP group can access Homewood and Second Life. Several have found that their computer or internet service is inadequate, they are unable to log in, or having done so have a very poor experience frequently freezing or crashing. Others have no problem and once they had learnt in Homewood how to use a virtual world they also moved into SL in order to join in various activities with large numbers of native speaking residents. It is only recently, with the improvement of the cable internet service that Homewood is able to cope with more than a very small group of avatars moving, building and talking, so greater numbers can now be encouraged to join in. This heterogeneous group of students, with their different reasons for and methods of learning constitute an interesting subject for observation. Their different attitudes and reactions to the resources that they experience in the Homewood islands and in SL, and their perceived and observed progress when joining in similar activities in Skype and second life can provide some insight into the effectiveness of the virtual worlds in their learning and language acquisition.

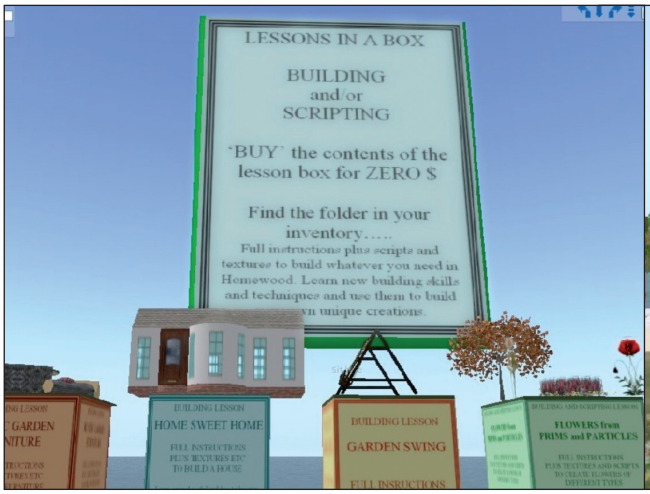


Figure 4 Building and scripting lessons



Figure 5 Building their own houses…

ELIP-Homewood resources available for language acquisition

The visual and immersive nature of the virtual world may make some activities seem more effective or memorable. It is certainly the case that in a Skype conference, none of the participants is surprised when one of the group is disturbed by their phone or doorbell, or someone else in their home environment; everyone is well aware the other participants in the conference are sitting at their computers in their own homes in other countries in distant parts of the world. Such disturbances seem to be less frequent and more surprising in virtual worlds which is only partly because ambient sounds in the virtual world mask all but major sounds in other participants' surroundings. Participants can become quite involved in the scene on their screens, some more so than others. But even the least engrossed student who knows that he or she is himself sitting in front of a computer, can see all the others, there in the virtual world. There is a tendency to identify other participants if not him/herself with their avatars and to think of them as really present together. This perception of presence in virtual worlds is recognised and used in psychological therapy *(Schuemie 2001)* but it is not always easy to discern whether this perception denotes increased cognitive engagement and learning *(Traphagan et al 2010)*.

Students who have used both Skype and the virtual world generally express a preference for the virtual world even for activities such as reading a book together where the surroundings would seem to be immaterial. Whether in Homewood or in SL, they like to sit in pleasant surroundings on a beach, in a park or in armchairs in a house and read together. Further research is needed to see the reason for such preferences and whether it has an effect on learning. Casual meetings and general chat is quite understandably easier or more interesting in a virtual world than in Skype; there is more to talk about. In a chance encounter in Skype, whether in a voice or text conference, after the usual greetings and introductions there is generally a pause, as participants stop and decide what to talk about. This hiatus quite frequently finishes the conversation completely. In a virtual world, however, there are generally shared surroundings and places to go. Observation shows the conversation is longer and is more likely to continue naturally until one or other of the participants has to leave.



Figure 7 …places to go…



Figure 6 …can see all the others, there…



Figure 8 ...sit in pleasant surroundings..

Language acquisition.

The wealth of detail and the many objects found in the virtual world, from items for sale in the supermarket and other shops to buildings, furniture, flowers and trees that form part of the scene can all be labelled. The names of these objects can be seen when they are selected for editing by clicking them with the mouse. Linking the names directly to the objects leads to association directly between the English word for the object and the object itself rather than a translation. Students who are wandering around in these surroundings and talking about what they can see and what they are doing are perhaps more likely to assimilate and use vocabulary naturally which may perhaps lead to acquisition which Krashen *(1982)* distinguishes from learning of language.

The 'comprehensible input' required *(Krashen, 1982)* for language acquisition is more likely to occur with combined visual and verbal clues available in a VW and the acquisition of new vocabulary happens naturally when window shopping and even more when actually choosing items to 'buy' for a little house where you can sit and chat to other students and show them what you have bought and made.

One of the activities used in the ELIP Skype conferences is playacting. Participants read a dialogue from a script, acting it out and imitating the pronunciation and 'tune' of English. The dialogues used are generally amusing and, accumulating over time, tell the life story of a group of people living in a neighbourhood in London; almost like a mini soap opera. These activities have been extended by creating some of the scenarios for these dialogues in the Homewood Virtual world. Playacting can now be done in situ and the scenes can be extended ad lib by the students. Some of the scripts together with notes and sound files have been placed in a box at the relevant location. This allows the lesson to be used without a teacher but changes the nature of the lesson from 'focus on form' *(Long 1998)* where queries about vocabulary, idiom, grammar etc are dealt with if and as they arise by the teacher in the Skype conference to a more planned, guided approach where notes are given about anticipated problems. It is too soon to gauge the success of these resources which have been prepared in response to requests from students who would like to study and practice in between scheduled lessons.

The most extensive use of the Homewood islands has been, and is intended to be for students to socialise and to collaborate on building projects and other activities. A virtual world seems to be ideal for 'task based learning' *(Ellis 2003, Willis 1996)* since collaboration on tasks requires communication in the target language which is generally the only common language of the group. However to practise their skills on native speakers they are encouraged to leave behind the cosy Homewood islands and venture into SL.



Figure 9 Scripts placed in a box.



Figure 10 ...stranger aspects...

And Second Life

In the context of ESL, the large pool of native English speakers is one of the main attractions of SL as opposed to small virtual worlds like ELIP~Homewood. In Homewood generally there are only other students to talk to. Even on OpenSim Hypergrids like Osgrid the population is a small fraction of that of SL. But in Homewood, ELIP members can learn the basic skills required in SL, can even learn to script and build and create things that they can sell in SL. They can gain in confidence before venturing into this larger world… just as overseas students in the many language schools in the centre of London can learn some basic language skills in classes, and then go out into Oxford Street and try them out on the natives *(or, more likely tourists from overseas!)* ELIP~Homewood students are encouraged to use SL as well as their own private world and almost all of them do so.

The major drawback of the limited opportunity for interaction with native speakers in ELIP~Homewood as opposed to SL is balanced by the vast area available for the creation of resources and the opportunities for students to engage in projects of their own like the houses they have built on Homewood 3, one of the islands. It would be impossibly expensive to buy so much land in SL or to have a private space dedicated to learning and free from the some of the stranger aspects of SL.

Some examples have been given here of how online language learning can be enhanced in a virtual environment and an account given of some of the resources being created in the Homewood, many by the students themselves. As the project unfolds the students and their engagement with these tasks and the VW will be observed in order to draw further conclusions about their learning and the efficacy of the VW.

Historical context

Three years ago at RELIVE08, Derrington & Homewood *(2008)* examined the emerging pedagogies in SL and ways in which second life was being used for teaching and learning a second language. Using Robins' taxonomy of Digital Spaces *(Robins 2007)* the relative affordances of SL, Skype and Real life were compared. The paper focussed on those things which language teachers normally do, which might be done more easily or more effectively in a virtual world than in a real classroom.

We extolled the virtues of Holodecks, *(Davis, 2010)*, Jeanberg *(2008)*, for their facility of presenting, at the touch of a button, different scenarios for role playing which is often used in communicative language classrooms *(Galloway 1993; Savignon 2002, Al Arishi 1994)* where teaching focuses on the development of competence through 'learner participation in communicative events' *(Savignon, 1990:210)*. We cited other activities like sightseeing which can be done much more easily as a virtual activity in SL than by arranging group outings for a language class in a real world. In a VW the whole class, still sitting comfortably at their computers wherever they are in the real world can visit art galleries, beaches, castles, gardens and parks and all the seven hundred wonders of the *(virtual)* world or even go dancing or shopping and get back home before the end of the lesson. On Homewood there is endless scope for them to engage together in projects and activities.

Quite apart from its facility for distance teaching, for bringing together students from all over the world, *(a common feature of ESL classes)* these activities can actually be done more easily or more effectively in SL than in a real classroom at the local further education college. The existence of communities in Second Life communicating as native speakers of the target language is another attractive feature. Visiting such places could be the equivalent of a holiday spent in a country among native speakers of the target language. As recounted above the ELIP~Homewood project is intended to observe language learners in a virtual world, to create resources and conditions to help them acquire accuracy and fluency in English and to understand how they learn and whether, why and how a virtual world can help them.

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Virtual Reality: Multiple Modes of Meaning

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Abstract

Our interaction with the richness and complexity of the "real" world is intuitive and tacit or 'proximal', Polanyi (1967). We know of the various types of things, what is real, and what is not. We gained this ability for many reasons least of all is through our evolutionary development. However, the same cannot be said of a "virtual" world which we create. This is primarily because of the presence of an interface, namely computer technology, between us and the virtual world. Though this interface is crucial and facilitates the creation of such worlds it nevertheless, brings in added complexities which can make virtual worlds seem to be less real and hence less intuitive than the actual real world. Virtual worlds have expressions of physical objects but they may also have visual expressions of non-physical things, there are non-avatar objects which are crucial and important elements of these worlds, there are auditory shapes flying around the screen, and so on. If computer technology is to create virtual worlds that are very proximal to the richness and intuitiveness of the reality of the real world then we must have a good account of what constitutes this reality. This is undoubtedly a philosophical question. Historically, reductionist schools of thought have had a major influence on our understanding of reality. Such an approach seems to be at odds with our everyday experience of reality which revolves around multiple and different modes of meaning. A typical object, such as plant, can have multiple meanings such as biotic, spatial, historical, commercial, aesthetic, and many more. Furthermore, none of these modes of meaning are at odd or in conflict with each other. It therefore, implies that the things we interact with in a virtual world might also have different modes of meaning and serve different purposes at the same time. This is a unique challenge for developers and designers for virtual worlds because of the limitations and restrictions imposed by existing reductionist frameworks of understanding. This paper introduces a new way of addressing this challenge through the proposal of fifteen ways or modes of meaning developed by the Dutch philosopher Herman Dooyeweerd. We will then explores its application particularly through its notions of "Individuality Structures" followed by the notion of "Enkapsis", to the question of modes of meaning and how this benefits the development of virtual reality applications and technologies.

Introduction: ontological questions

Virtual reality is becoming increasingly important as a learning tool in education. It has been widely used in teaching particularly in medical disciplines and some in engineering, Park et al (2007) and Kuester at al (2007). In terms of technological developments there have been great strides in the delivery of advanced technological capabilities. Roussou (2000) identifies as mature the status of virtual reality as a technology. However, despite this apparent maturity the technology itself is still to prove its value in enhancing learning outcomes in an educational context as pointed out by Lee and Wong (2008).

In their study looking at uses of virtual reality in education Saanchez, et al *(2000)* point to the lack of any theoretical foundation that underpins the understanding and use of this technology. Their study makes an interesting observation into the gap between what exists and is represented in the computer and what is out there in the real world. They cite these examples as contributors to the gap:

- Lack of "clear correspondence in the real world".
- "knowledge concerned is `invisible', having no profiles or physical observations".
- "concepts that are complicated to represent".

The gap between the technology and the diversity and richness of real world requirements can only lead to inappropriateness and reduced usefulness of the technology for its intended application. Richardson *(2001)* identifies the learning curve of such technologies and applications as a source of difficulty.

The evidence for limitations of virtual reality applications in education point to how we understand reality itself, what exists, and how such an understanding is extrapolated to structure and form virtual reality worlds.

The influence of reductionism

Reductionist ways of thinking have influenced much of modern day technological developments. Wilson EO *(1998)* describes the essence of a reductionist approach: *"to fold the laws and principles of each level of organization into those at more general, hence more fundamental, levels"*. In their response to the gap issues Saanchez, et al *(2000)* proposed a generic model for developing virtual reality applications. The model is primarily based around the notion that virtual reality is about visualization of cognition. Jones *(2000)* on the other hand sees virtual reality as a modeling environment in which we need to embed human qualities. He identifies two such areas namely the biological and emotional.

Reflecting on a history of 2,000 years Heim *(2002)* agrees that defining reality isn't going to happen overnight; therefore, defining virtual reality won't happen overnight either. Heim suggests the embedding of our understanding of virtual reality in what he calls the *"cultural energy needed to propel it forward"*.

The influence of a reductionist view of reality is overwhelming and seems to drive how we develop and interact with the world through this technology. So, what is the problem with such influences?

The problem with reductionism: issues of existence

Existence in real and virtual worlds is shaped by diversity and richness. An entity such as an avatar has multiple modes of existence which a reductionist theory fails to fully or adequately capture. In his work on understanding uses of virtual reality in physiology Richardson *(2001)* suggests that reductionist thinking has led physiologists astray for over 60 years. He concludes that virtual reality can be a useful tool in the teaching of physiology so long as the complexity of living systems is taken into account.

Dahlberg *(2004)* discussed limitations of reductionist ways of understanding technology such as virtual reality and citing the roots of the problems to separating technology from its social context, and narrowly focusing upon a single aspect of determination. Dahlberg calls for showing greater sensitivity to the multiplicity, complexity and often intersecting interplay between the elements that make up the being of any technology. This view is extended to include virtual reality environments.

Deutsch *(1997)* in his critique of reductionist ways of understanding reality shows how things cannot be properly understood based on what he calls *"lower level theories"*. He demonstrates this by explaining how it would be difficulty to account for the statue of Winston Churchill purely based on the lower level laws of physics. Such laws may well predict and describe the formation of bronze molecules into a statue but cannot account for a true understanding of why the statue was made. Deutsch calls for a *"deeper insight into "The Fabric of Reality""*.

So, where is the evidence for the multiplicity of types of existence that are found in a virtual world?

Multiple types of existence

Grudn *(2008)* speaks of a number of complicating issues within any virtual world to contend with, such as:

1. The bigger picture of the virtual reality including the role of the programmers and the underlying software.
2. Representing the relationships rather than simply the objects present in the virtual environment simulated. For example between avatars, avatars and us, etc.
3. Meaning of spatial distances between for example an avatar and an object.

All these issues are distinct from each other require a separate treatment.

A virtual world is not only composed of physical things. In an earlier paper Basden *(1999)* lists a number of examples of visual expression of non physical things:

1. Spatially representing some of the concepts pertinent to the virtual topic.
2. Labels indicating names of avatars, etc.
3. Ways of conveying the content of the topic.
4. Ways, perhaps using color, to indicate stat of objects, state of discussion, etc.

Aside from the visual scene one could also identify an array of different types of existences such as:

- Human Participants
- Avatars
- Synthetic agents
- Non material objects
- Properties of objects
- Symbolic representation
- Data structures needed to hold information about objects, shapes, etc.
- Bits of data
- Logic gates
- Computer, screen, mouse, storage disk, network, etc.
- Pixels
- Luminance material
- Silicon
- etc..

The reader is entitled to ask why is it necessary to know such types of existences and why should we be concerned with their ontic status in the context of virtual reality environments? The question faced is this: in what sense do these various elements exist?

The possibility of different modes of being seems to be compatible with our everyday experience. When one says *"The computer is a PC"*, *" The computer is a server"*, *" The computer is a network node"*, one is stating various modes of being, and all can be true without contradiction. Therefore the things we encounter in a virtual environment might also have different modes of being, and can be different things at the same time. The notion of various modes being also gives both richness and freedom to our discussion of ontological status. It allows us to posit kinds of existence that are radically different from each other without being under pressure to reduce them to a single mode.

Consider, for example, a scene from a virtual reality environment: it is communicating a message *(lingual thing)*, a structure *(formative thing)*, a collection of concepts *(analytical)*, avatars showing feeling*(s) (sensitive thing)*, marks on screen when displayed *(physical)*, a bonding experience *(social thing)*, and an excellent display *(economic thing)*. It is therefore natural to say that an avatar exists in various modes similar to the above list. However, the various items of the list do not exist in isolation of each but rather in an integrated and various ways. It is this type of integrated existence that the rest of the paper focuses on.

Multiple modes of being: a philosophical approach

We will take Dooyeweerd's proposal, namely of fifteen ways of being and use it to underpin the approach of this paper. Dooyeweerd delineated fifteen aspects of our everyday experience, Table 1.

What aspects are and how this helps us

Aspects are the diverse ways in which all creation functions. Each is a sphere of cosmic meaning-and-law-promise which is distinct from all other such spheres. Thus, for example, the lingual aspect enables us to structure

Aspect	Example things
Quantitative	Amount, Proportion
Spatial	Shape, Distance, Angle,Direction
Kinematic	Path or Route, Flow
Physical	Energy, Waves, Particles, Materials, Fields, Forces, Rocks
Biotic	Plants, Organism, Organ, Tissue, Cell
Sensitive	Animals, Sound, Colour, Feeling, Emotion, Excitation
Analytical	Concept, Distinction, Deduction, Awareness
Formative	Goal, Achievement, Forming, Will, Tool, Skill
Lingual	Word or Sentence, Book, Writing, Utterance, Diagram, Index
Social	Friendship, Institution, Status, Respect
Economic	Resource, Limit, Production and Consumption, Money, Management
Aesthetic	Music, Sculpture, Cuisine, Humour, Fun, Sport, Nuance
Juridical	Responnsibility and Rights, Rewards and Punishment, Laws
Ethical	Self-Giving Love, Generosity, Sacrafice
Pistic	Faith, Trust, Loyalty, Worship, Commitment, Ritual

Table 1 Aspects and what they mean, Basden *(2007)*

our utterances according to the syntax of the language we are using then people will more readily understand us, and by reference to the lingual aspect such things as sentence, spelling, signification are meaningful to us and may be studied.

Aspects provide us with a number of unique roles that we can utilize to improve our research and practice:

- Aspects are ways in which things can be meaningful. For example a key can be meaningful to us in the legal, spatial and physical aspects especially, as exemplified above. This gives us distinct categories of meaning, useful during analysis.
- Aspects are different ways in which things make sense: so they provide different

  kinds of rationality such that we can for example different the physical from social.
- Aspects are modes of being. For example a diagram is communicating *(lingual thing)* some purpose through a structure *(spatial)*. a collection of concepts *(analytical)*, pleasant diagram to look at *(sensitive)* thing, and so on.
- Aspects provide distinct ways of relating: for example physical, logical, social, legal relationships.
- These roles are given by way of example as the full potential of aspects is beyond the text of the paper.

Characteristics of aspects

Dooyeweerd's discussion highlights various characteristics that aspects have:

- Aspects transcend us and their laws pertain throughout all cultures and times. This means that repercussions occur even if we don't recognise them, helping us understand unintended consequences.
- Aspects are irreducible to each other in respect of their meaning. This means none can be ignored during analysis.
- Aspects function in harmony with each other. For example being ethical need not make a company uneconomic, nor vice versa: the laws of the ethical and economic aspect are in harmony, not conflict.
- Mutual echoes: Each aspect contains echoes of the meaning of all the others: the analogical inter-aspect relationship, which helps us acknowledge metaphor etc.

Constructed artifacts rarely, if at all, exist in terms of a single aspect. Dooyeweerd's account for the integrality of entities around the concept of enkapsis. The various modally qualified entities are enkaptically related; the first example he explored in his New Critique is Praxiteles' marble statue; it has a physical mode of being as a block of marble, and an aesthetic mode of being as a statue. Several different types of enkapsis became apparent, these were:

1. Foundational enkapsis, as in a statue and the marble of which it is made.
2. Subject-object enkapsis, as in a snail and its shell.
3. Symbiotic enkapsis, as in clover and nitrogen-fixing bacteria
4. Correlative enkapsis, as in a forest and its animals
5. Direct territorial enkapsis, as in a state and its hospitals
6. Indirect territorial enkapsis, as in a state and its tax-payers or its universities

We will explore these various types of enkapsis to give a new understanding of existence of virtual reality environments.

Dooyeweerdian view of virtual environment

Here we focus attention on the first type of enkapsis namely Foundational enkapsis to demonstrate how it applies to components of virtual environments. An example of foundational enkapsis is in a statue and the marble of which it is made. In this type talk is of necessary aspectual relationships. That is, one thing *(sculpture)* depends on another thing *(marble)* that has independent meaning of its own in a different *(usually earlier)* aspect. In the context of a virtual environment consider the materials - components *(Gates and Blobs)*. The relationship between materials and the components manufactured out of them is like that between the marble and the statue: foundational enkapsis. The physical materials are formed into components for a purpose. Similarly, when we consider Blobs and Pixels we are essentially talking of two distinct structures. To call the pixel a pixel is to talk sensitively *(because we are emphasizing its being a meaningful stimulus of the human eye)* whereas to call the pixel an activated blob is to talk physically. Therefore there are two entities in this individuality structure: a sensitive and a physical one. What is the relationship between the human participants and their avatars? At first sight it might be a subject-object relationship. It seems as though the relationship between a human participant and avatar is more like that between a snail and its shell. The shell is enkaptically bound to the snail by subject-object enkapsis. In the same way the avatar is enkaptically bound to the human participant by subject-object enkapsis. However, there is a difference between the two cases. An avatar exists in a sensory aspect whilst the human participants exist in all aspects. This form of enkapsis is unique one which requires discussion that goes beyond the scope of this paper.

Implications of the approach

It is not uncommon to see technological devices and environments get in the way of communicating education to learners. To overcome such hindrances designers need to create tools and applications that are intuitive and have little cognitive load. Polanyi *(1967)* through his concept of proximal and tacit knowledge offers one such vision of technology. At an operational level tacit knowledge could be seen as offering advantage to the tool designers by reducing cognitive load, freeing the mind from one level of a task to enable thought to be directed at another. Polanyi sees intellectual and practical knowledge interwoven: *"These two aspects of knowing have a similar structure and neither is ever present without the other.... I shall always speak of 'knowing', therefore, to cover both practical and theoretical knowledge."* It seems that this integrated view of knowledge is in parallel with our aspectual approach. So from purely this perspective one can see educational tools such as virtual reality environments could benefit from our approach. Also, the notion of irreducibility of aspects being so central to our approach gives designers the freedom to create applications without being forced to conflate or reduce entities and features into one another. Diversity is places right at the forefront of our approach.

Conclusion

This paper introduced a new approach to think about virtual reality and their role in an educational context. The approach is rooted in a non-reductionist philosophy thus giving the approach a firm foundation and one which ties in theory and practice in an integrated fashion. The suggested way forward for the development of such technologies is one that recognises a reality that is diverse and coherent. Further work is being carried out at the University of Essex to set a research agenda to inform and enrich our understanding of virtual reality applications across a variety of applications including the ver important one of education.

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The strength of cohesive ties: discursive construction of an online learning community

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Abstract

Learning takes place in a social context and this context can offer many resources, including structure, continuity and motivation. Online, two primary learning types of context have been identified, networks and communities. While networks may offer a wealth of people and resources, communities appear to offer richer learning possibilities. It is therefore important to investigate how online learning communities can be formed from online networks, and whether such a shift benefits learners. The study reported here focuses on two groups of teenagers, one a formal learning group from the USA and the other an informal learning group from the UK. The groups were originally only weakly tied in a network, but aimed to create a single learning community through activity in an online forum, wiki and virtual world. Thematic analysis of their forum posts shows the importance of cohesive ties – grammatical devices used to construct coherent narratives – to the development of key elements of community: spirit, authority, trade and art.

Introduction

Learning is a social endeavour that takes place in a social context *(Bandura, 1971; Vygotsky, 1987)*. At one level this is to do with the development and supply of resources. Connecting with others gives us access to expertise, to people who can guide, model, challenge, teach and work with us. It gives us access to physical tools such as books and computers, and to psychological tools such as language and numbers *(Vygotsky, 1997)*. It also provides us with contexts within which we can understand those resources, frameworks for learning within which we have a role *(for example, as learner, teacher or expert)*, opportunities for the joint negotiation and development of ideas, historical settings within which we can help to develop continuous threads of knowledge, and affective elements such as motivation and confidence that can support our learning *(Clark & Brennan, 1991; Claxton, 2002; Wells & Claxton, 2002)*.

Digital technologies can be used as resources to support and supplement existing social relationships. In terms of learning, these online connections are typically conceptualized either as networks or as communities. The Centre for Studies of Advanced Learning Technology *(CSALT)* group at Lancaster University defines networked learning as

> learning in which information and communication technology *(C&IT)* is used to promote connections: between one learner and other learners, between learners and tutors; between a learning community and its learning resources. *(C. Jones, 2004)*

Learning networks are made up of actors *(both people and resources)* and the ties between them. These ties can be classified as strong or weak, depending on their frequency, quality or importance. A weak tie has the capacity to act as a 'bridge', the only route between two sets of actors in a network *(Granovetter, 1973)*. Online networks can offer learners easy access to large sets of people and resources and

a wide range of perspectives and may support both cooperation and collaboration *(Haythornthwaite & De Laat, 2010)*.

However, in order for groups of learners to work together successfully, they need to develop shared understanding of what they are trying to achieve, and shared knowledge on which they can build. Such shared, or common, knowledge is built through discourse and joint action and forms the contextual basis for further discussion *(Edwards & Mercer, 1989)*. The temporal elements of context mean that shared history is an important resource; learners can refer back to past discussion, actions or events *(Mercer, 2000)* and can develop a shared understanding of their current actions and their future intentions. This development and deployment of shared contexts, discourses and histories is associated with communities.

There are many types of community associated with learning, including communities of practice, communities of interest and communities of learners *(Goodfellow, 2003; A. Jones & Preece, 2006; Wenger, 1998)*. At heart, they all share four common characteristics, described in detail by McMillan *(1996)*: spirit, trust, trade and art. Spirit is associated with friendship, and feelings of belonging. It is made possible by boundaries, and ways of testing that new recruits will be loyal to the community. Trust is associated with authority, group norms and, ultimately, with justice. Once a community has a live spirit and an authority structure that can be trusted, members discover ways in which they can benefit one another and the community. Together, spirit, trust and trade combine to form a shared history that becomes the community's story symbolized in art.

In the physical world, a sense of community is strongly associated with place, and pre-Internet definitions of community emphasised location *(Bell & Newby, 1971)*. Online, communities tend to be associated with 'cyber-settlements' which offer a minimum level of interactivity and sustained membership, a variety of communicators and a common public space *(Q. Jones, 1997)*. Constructing the settlement, though, is just the beginning. Communities need leadership, support, governance, acknowledgement, entertainment and amusement *(A. Jones & Preece, 2006)*, and in an online community these will primarily be constructed through the use of dialogue and the development of a shared discourse.

In a community set up to support formal learning, where goals and means of achieving them are decided by the teacher *(Vavoula, 2004)*, this is relatively straightforward. In most countries, learners are socialised from an early age to recognise standard elements of classroom discourse *(Sinclair & Coulthard, 1975)*. In informal learning situations, where goals and means of achieving them are non-specific or are set by the learner *(Vavoula, 2004)*, a greater variety of discourses is available, and the opportunities for misunderstanding and incoherent exchanges are thus increased. The creation of online learning communities is therefore intertwined with the establishment of coherent discussion.

Coherence in speech, writing and online forums is established by register – the set of meanings for language that are appropriate to the event – and by cohesive ties, grammatical devices that bind sentences, utterances and longer passages together *(Ferguson, 2009; Halliday & Hasan, 1985)*. These include the use of paraphrasing, repetition, references, sets of words that are lexically related and substitution of one word or phrase for another.

These devices support the development of coherence, but do they support the development of online learning communities? Goodfellow *(2003)* notes that such communities take time to develop; so opportunities to track and analyse how they are discursively produced are necessarily rare. Despite these difficulties, as online social learning becomes increasingly important and we seek to build learning communities upon and within learning networks *(Conole, 2008; Ferguson & Buckingham Shum, 2011; Walton, Weller, & Conole, 2008)*, it is important that we ask

- What roles do cohesive ties and register play in the construction of online learning communities?

Data collection

In order to answer this question, this study draws on data from the encounter of two learning communities, one formal and one informal, within an online learning environment. The data is taken from Schome *(Twining, 2010)*, 'a new form of educational system designed to overcome the problems associated with current education systems in order to meet the needs of society and individuals in the 21st century' *(Sheehy, Ferguson, & Clough, 2007)*. In 2007, the project opened the Schome Park Programme in the virtual world of Teen Second Life®. Participants who joined in 2007 included individual teenagers from across the UK, supported by adult educators who also considered themselves learners. They interacted on the virtual island of Schome Park, and also in the Schome forum and wiki. Although the majority of participants had never met face to face, a strong sense of community developed, and members referred to themselves as the Schommunity.

Pseudonym	Example things	No. of Postings
1USStaff	US Staff	3
1GBStaff	England Staff	6
2GBStaff	England Staff	3
3GBStaff	England Staff	3
4GBStaff	England Staff	2
5GBStaff	England Staff	2
6GBStaff	England Staff	1
1USTeen	England Staff	21
2USTeen	US Teen	6
3USTeen	US Teen	3
4USTeen	US Teen	2
5USTeen	US Teen	2
6USTeen	US Teen	2
7USTeen	US Teen	2
8USTeen	US Teen	2
9USTeen	US Teen	1
10USTeen	US Teen	1
11USTeen	US Teen	Co-authored 1
1GBTeen	England Teen	19
2GBTeen	England Teen	18
3GBTeen	England Teen	14
4GBTeen	England Teen	12
5GBTeen	England Teen	12
6GBTeen	England Teen	9
7GBTeen	England Teen	7
8GBTeen	England Teen	6
9GBTeen	England Teen	3
10GBTeen	England Teen	3
11GBTeen	England Teen	2

Table 1 Those who participated in the forum thread, their pseudonyms, roles, and number of postings within the thread.

The third phase of the Programme ran from January to June 2008 and explored the interface/co-existence of Schome and school. The Schommunity was informal and had no attendance requirements or assessed tasks; teenagers participated as and when they chose, with a focus on the development of knowledge-age skills such as leadership and creativity. A formal learning community, a high-school computing class from Los Angeles, joined them in March 2008. The two communities had formed part of a network related to new approaches to education. Within this network, they had been connected by one 'bridge', the weak tie between Schome's director, 1GBStaff *(see Table 1 for an overview of pseudonyms used in this article)*, and the class teacher, 1US Staff. There were significant differences between the two communities: the Schommunity was informal, mainly based in the UK, familiar with the online environment and primarily interacted online, while the US community was formal, unfamiliar with the online environment and primarily interacted in a face-to-face setting.

The Schome Park Programme generated an enormous dataset including forum postings, virtual artefacts, media assets and records of in-world chat. Our broad analytic approach to this dataset is virtual literacy ethnography *(Gillen, 2009)*. This approach acknowledges that our analysis of the literacy practices within the dataset is informed and influenced by our longstanding engagement with the Schommunity and with the data generated by the community. To answer the research question posed by this study, we carried out a thematic analysis of one forum thread, taking as our themes the key elements of community – spirit, trust, trade and art – and considering the roles played by cohesive ties and register in the construction of these.

This forum thread was selected as an exemplar of the extensive discussions and interactions between the two communities that took place during spring 2008. It includes the written participation of 28 members of the Schome Park Programme *(including two of this article's authors)* and, when we began our analysis, it had been read 12,727 times. It is a long thread, created over three weeks, and including 166 separate posts with a total word count of 27,871 *(to put this number in context, the thread is 80 words shorter than Shakespeare's play, 'Othello')*. It was by no means the only discussion that took place at the time – while this thread was open there were 1278 other postings on the forum, three weeks of engagement in the virtual world, and extensive use of the project wiki. Nevertheless, it represents the main threads of discussion around the challenges and opportunities presented as the two groups negotiated an understanding of community.

In the data presented below, note that spelling, punctuation and grammar have not been standardized, and that the gender adopted or attributed to participants in Schome may not represent their offline gender.

Data analysis

Spirit

The forum thread began with a posting from 1USStaff, headed '1USStaff's Team Events'

> *"Greetings to all,*
>
> *I will be posting events for various members of our team.They would post themselves, but we are a bit short of time and attendance is not always steady*
>
> *Being newbies, I hope I am doing the right thing. Please let me know if I need revisions.*
>
> *We would love to have anyone participate in planning the events as well as attending, so feel free to join any group. 1USStaff"*

There is an immediate confusion of cohesive ties here as names and pronouns are presented ambiguously *(1USStaff's Team, all, our team, they, we, group)* and the text shifts uncertainly from the first to the third person and from membership to leadership. The next afternoon's postings from the US students suggested a more formal approach was being employed in the classroom; the students were not functioning as a 'team' but were working as singletons or pairs to propose an event in the virtual world and to evaluate another proposal. Figures 1 and 2 give a flavour of these exchanges, which employ a familiar educational register – the teacher assigns written work and provides a framework or template. The pronoun 'we' in these postings

clearly refers to the sub-groups within which students were working rather than to the community. Eight of the ten US students who posted in this thread repeated this format. They posted a proposal and/or an evaluation, used 'we' to refer to themselves and their project partner, and did not engage with the discussion thread in any other way.

In the context of the Schome forum, the appearance of assessed work and of postings that did not form a part of a dialogue was unusual. As the forum thread progressed and debate became increasingly heated, the occasional interjection of formulaic evaluations became increasingly jarring. When 6USTeen posted

> *That sounds like a ton of fun 3USTeen! How on earth did you come up with such a brilliant idea lol Make sure there is a way to modify the guns and you'll probably need to be a way to inform people of the time as it runs ou".*

in the middle of what had become a fast-moving discussion on religion, 5GBTeen responded

> *I wish to make clear that I am now no longer intending to participate in this project for as long as 1USStaff is busily destroying the whole concept".*

The evaluation had not been interpreted as a difference in register, but as a challenge to the Schommunity. 10GBTeen agreed with this view,

> *In terms of the existence of final projects and suchlike, I tend to agree with 5GBTeen- it isn't at all part of the schome ethos*

Here 'the Schome ethos' made its first appearance in the discussion, substituting for 'the whole concept' and prompting a query from1USTeen

> *Look, I joined in a bit later than most. What is, in your terms, the Schome ethos, then?*

7GBTeen provided a detailed response, referencing the relevant wiki page, and a reformulation of the information on that page, aligning it with the concerns of the ongoing discussion:

> *On the schome ethos it basically runs down into some main points. One being that you are not forced to learn if you choose not to - If I don't choose to go to an event I'm not forced to, If I do then I may.*
>
> *The main conflicting element of this for the most part is the school philosophy, school lessons nine times out of ten are very structured, you are told what to learn, when to learn it, how to learn it, attendance is compulsory, Learning is compulsory even if the subject is of no interest (school and homework make sure of it)".*

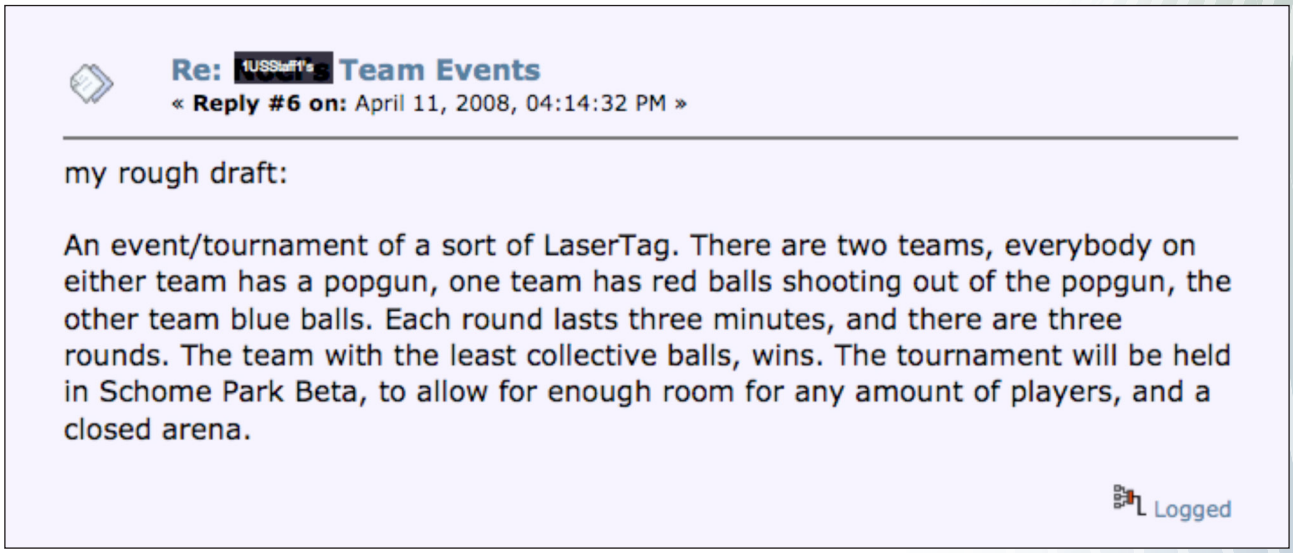


Figure 1 Reply #6, posted by 3USTeen.

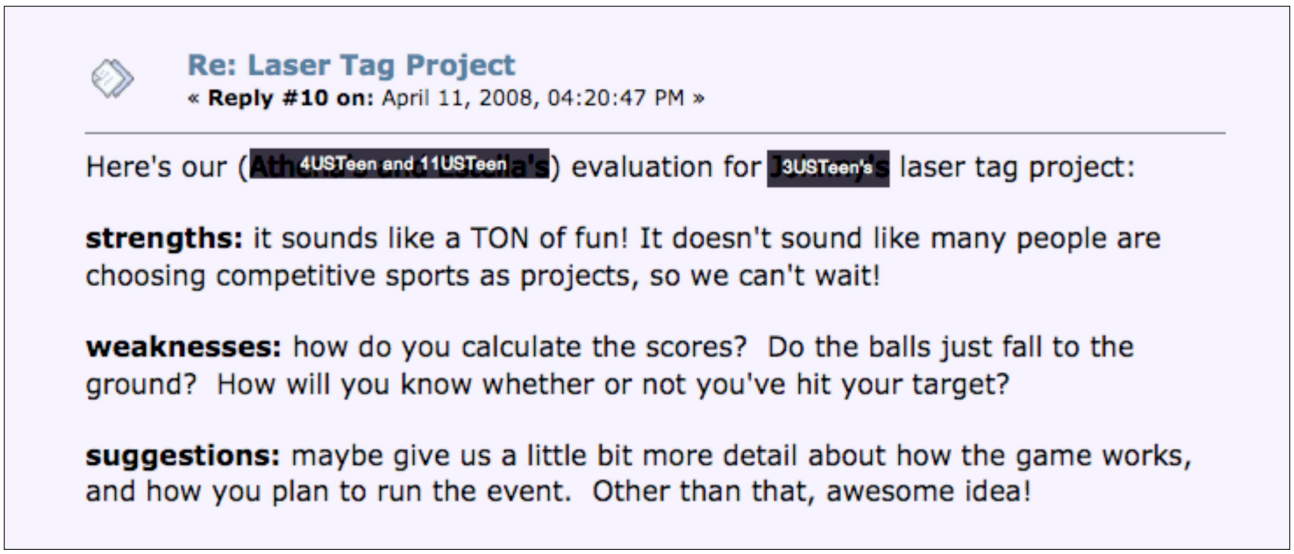


Figure 2 Reply #10, posted by 4USTeen.

The thread includes many reformulations of 'the schome ethos', which was in part defined in opposition to the register of postings by members of the US community – Schommunity members made it clear that this ethos did not involve final projects, three-line evaluations or graded coursework, which meant it effectively excluded all contributions to the discussion thread by eight of the US participants, and placed the contributions of the others in doubt.

Trust

Two of the US teenagers did engage with the idea of the Schome ethos, including 1USTeen. From the start of his engagement with the thread *(Figure 3)*, he employed the same register as members of the Schommunity, employing similar ideas, style and terminology. Unlike his fellow students he introduced himself, set out his credentials and engaged with the Schommunity by asking for members' help and their thoughts. In his next posting he asked the community to 'green-light this project'. In doing so, he acknowledged the authority of the Schommunity, and this produced a tension for him because he then had to try to align the requirements of both communities, one concerned with the ongoing development of knowledge-age skills and one concerned with the development and assessed demonstration of computing skills. When asked why he wanted to build the cathedral, 1USTeen set out five reasons, including:

> *"Because a good deal of my grade in 1USStaff's class is riding on this project and I'm starting to approach the point where I won't have time to start over."*

Schommunity members objected to grading but nevertheless engaged in a cohesive discussion around the related terms 'grade', 'mark' and 'A*'. 4GBTeen suggested 'Could this debate not get you a mark - demonstrating different skills?', a view repeated and developed by 3GBTeen: 'For engaging in this debate alone and how well you are presenting your augment etc alone you should get a A*'. 1USTeen's response, though, was 'Hah, I wish. No, we have to actually make something in second life - it's a computer class.' The US community did not treat its rules, authority and standards as negotiable within the Schommunity forum, and no cohesive ties were created between the two communities on this subject.

Trade

The start of the discussion thread had a networked style to it, with postings apparently offering access to people and resources. 3GBTeen offered to record some cornet music for the concert group, and mentioned access to resources related to laser tag. Yet members of the US community did not respond to these offers – such a response would have meant shifting register away from assessed work and into discussion.

In the forum there was little other opportunity for the trade of material goods, but participants proved willing to offer a wealth of ideas, challenges, discussion and debate.

Figure 4 *(Page 62)* gives an indication of how this worked in practice. This post from 1USTeen made use of the forum's quotation facility to build strong cohesive ties between the postings of different people. No posting was quoted in full, but key sentences were selected for response. The extensive use of selective quotation to keep numerous lines of discussion in play at once would be impossible in face-to-face discussion, and would almost certainly lack coherence in synchronous online discussion. Here it was deftly employed to manage the exchange of intellectual ideas between several people.

In the space of just one posting, 1USTeen replied to four members of the Schommunity, responded to challenges, raised counter-challenges, shared personal interests and beliefs, offered clarifications and modifications, raised questions, provided information about Gothic architecture and introduced new issues. He also built cohesive ties into his posting – his responses to the idea of building a Gaudi-style cathedral were numbered first, second, third – his reasons for building a cathedral in the first place were numbered one to five. In doing so, he constructed a framework for future discussion – members of the Schommunity could, and did, respond to separate points. The posting as a whole was a sophisticated construction that formed part of an extensive exchange of ideas.

Art

Part of that exchange involved the construction of a shared understanding of elements of the history and art of Schome. It became clear at various points in the discussion that although members of different communities were using the same words and referring to the same things, these cohesive ties were not creating coherence because their register was interpreted in different ways. When 1USTeen introduced himself *(Figure 4)*

> *Oi. I'm the angel with the black wings and the gun, if you've seen me.*
> *My building project idea is the Moishe Z. Liebowitz Memorial Cathedral.*

his proposal 'was an in-joke between me and my friends'. His classmates knew that he was an observant Jew, they would have recognised *(as the UK teenagers do not appear to have done)* that Moishe Z. Leibowitz is a Jewish name, and that there was a comic tension between 'Moishe Z. Leibowitz' and 'cathedral'

Re: 1USStaff Team Events
« Reply #7 on: April 11, 2008, 04:15:54 PM »

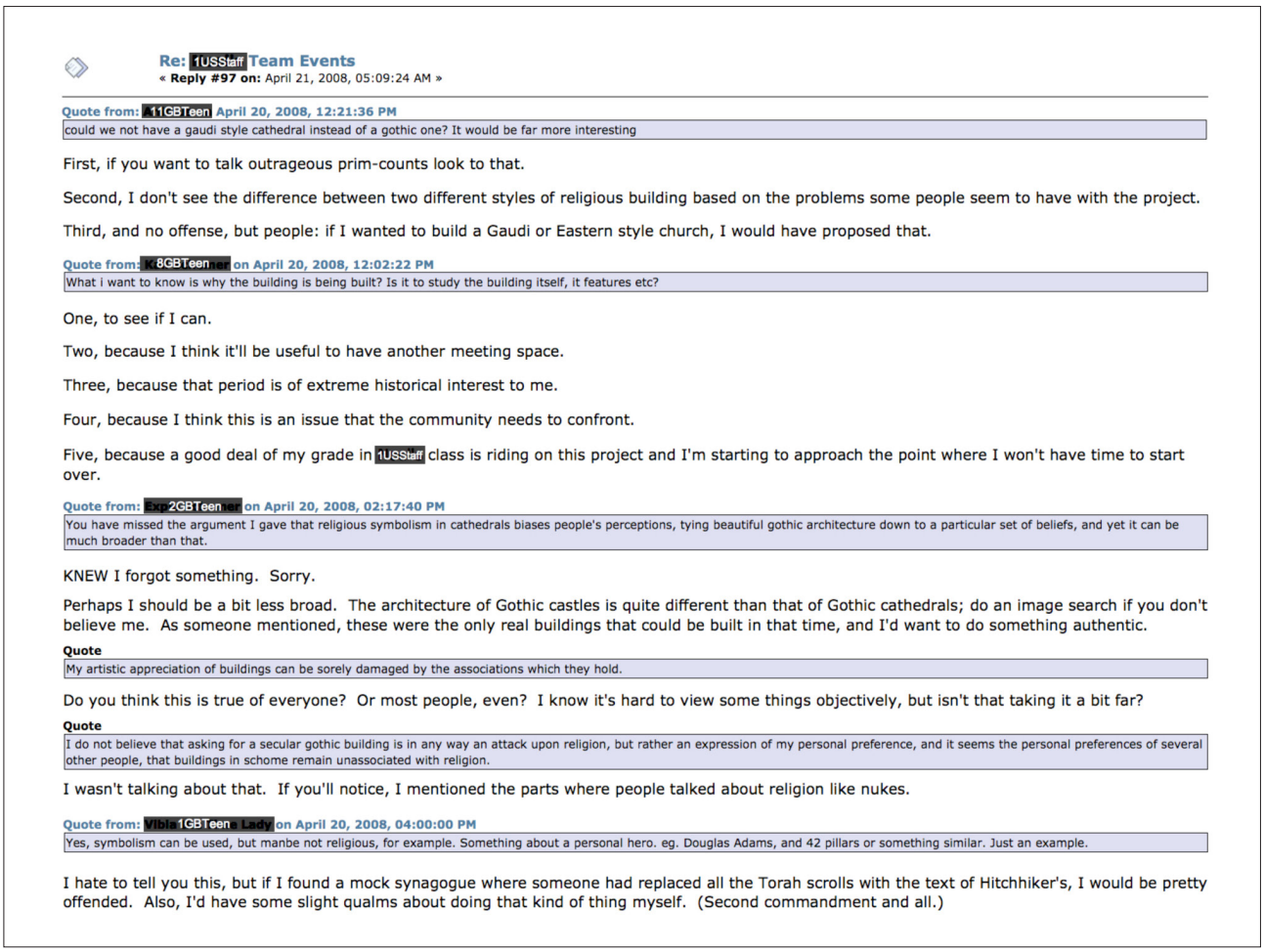
Oi. I'm the angel with the black wings and the gun, if you've seen me.

My building project idea is the Moishe Z. Liebowitz Memorial Cathedral. Due to my lack of time in the next two months, mostly because of AP testing and my large role in Ghetto, I've decided on a "rolling building plan." I intend to finish the basic structure of a simple cathedral rather quickly, with very basic textures and no furniture. From there I will add furniture, improve textures, add building detail in more visible areas like the exterior front, and then in less visible areas such as interior corners.

With the exception of the main cathedral, none of these projects will have an exact target date; they'll be implemented in rolling releases leading up to May 26th, the opening day. Optimally the opening day would culminate with a universal service of some kind – all religions welcome, that sort of thing – but I realize that there may be problems with this on both ends of the puddle, so I'm open to something as little as just having people look around.

Here are the four things I need most right now. First, if anyone has links to actual cathedral blueprints I could look at for reference, that would be great. Second, I would love recommendations for textures to use, especially for the windows. Third, ideas for a location are much appreciated. Finally, I want to ear everyone's thoughts on the service suggested. I'd prefer to have it be unaffiliated with any religion, sort of like a Unitarian thing, but it may not be possible anyway. Thoughts?

Figure 3 Reply#7, posted by 1USStudent.



Re: 1USStaff Team Events
« **Reply #97 on:** April 21, 2008, 05:09:24 AM »

Quote from: 11GBTeen April 20, 2008, 12:21:36 PM
could we not have a gaudi style cathedral instead of a gothic one? It would be far more interesting

First, if you want to talk outrageous prim-counts look to that.

Second, I don't see the difference between two different styles of religious building based on the problems some people seem to have with the project.

Third, and no offense, but people: if I wanted to build a Gaudi or Eastern style church, I would have proposed that.

Quote from: K8GBTeen on April 20, 2008, 12:02:22 PM
What i want to know is why the building is being built? Is it to study the building itself, it features etc?

One, to see if I can.

Two, because I think it'll be useful to have another meeting space.

Three, because that period is of extreme historical interest to me.

Four, because I think this is an issue that the community needs to confront.

Five, because a good deal of my grade in 1USStaff class is riding on this project and I'm starting to approach the point where I won't have time to start over.

Quote from: Exp2GBTeen on April 20, 2008, 02:17:40 PM
You have missed the argument I gave that religious symbolism in cathedrals biases people's perceptions, tying beautiful gothic architecture down to a particular set of beliefs, and yet it can be much broader than that.

KNEW I forgot something. Sorry.

Perhaps I should be a bit less broad. The architecture of Gothic castles is quite different than that of Gothic cathedrals; do an image search if you don't believe me. As someone mentioned, these were the only real buildings that could be built in that time, and I'd want to do something authentic.

Quote
My artistic appreciation of buildings can be sorely damaged by the associations which they hold.

Do you think this is true of everyone? Or most people, even? I know it's hard to view some things objectively, but isn't that taking it a bit far?

Quote
I do not believe that asking for a secular gothic building is in any way an attack upon religion, but rather an expression of my personal preference, and it seems the personal preferences of several other people, that buildings in schome remain unassociated with religion.

I wasn't talking about that. If you'll notice, I mentioned the parts where people talked about religion like nukes.

Quote from: Viola1GBTeen Lady on April 20, 2008, 04:00:00 PM
Yes, symbolism can be used, but manbe not religious, for example. Something about a personal hero. eg. Douglas Adams, and 42 pillars or something similar. Just an example.

I hate to tell you this, but if I found a mock synagogue where someone had replaced all the Torah scrolls with the text of Hitchhiker's, I would be pretty offended. Also, I'd have some slight qualms about doing that kind of thing myself. (Second commandment and all.)

Figure 4 Reply#97, posted by 1USTeen

just as there was between 'angel' and 'gun'. The Schommunity missed the joke completely.

Later in the thread 2USTeen commented 'It is strange to us as Americans that some people might not want to ebrace religion into the project', suggesting that the significance and relevance of the topic had also been misunderstood. The two communities had engaged with each other for several weeks before they began to identify these subtle differences in register.

These misinterpretations also existed within the Schommunity, and sometimes it was the newcomers who helped the Schommunity understand their own art and history. 'The Hawaiian Shirt', a beach bar on Schome's virtual island, was misinterpreted by 1USTeen. 'Isn't the Hawaiian Shirt an expression of native Hawaiian culture?' he asked. 2GBTeen gave a logical, but misleading, explanation for its name

the Hawai'ian Shirt has no reference, that I know of, to native Hawai'ian culture, and is instead a reference to the relaxed atmosphere linked with a beach hut.

Once the subject had been raised, 3GBTeen could supply a more accurate explanation – it was actually an in-joke, referring to the fashion sense of a former staff member

it's a... joke/comon knowledge - something that you'd have to have met Mark Cabaret to understand.

In the case of the island's 'Japanese Garden' on the island, the teenagers in the Schommunity members referred to it on several occasions as a tranquil, non-religious place to hold ethical debates, but 1USTeen reinterpreted the location for them by pointing out the Shinto significance of its kami gate.

Discussion

This forum thread was a focus for the discussion and negotiation of all four key elements of community – spirit, trust, trade and art *(McMillan, 1996)*. In each case, cohesive ties and register were implicated in its construction and maintenance. The development of community was closely tied to the joint authorship and understanding of a sustained and coherent narrative. When the thread lacked coherence, as it did when members of the US community posted reviews without linking these to their immediate context, it resembled the activity stream of a social network, where postings of different styles, types and themes share nothing but a temporal link.

All participants used cohesive ties to produce coherence within individual posts. When these internal ties were confusing or contradictory, as in the case of the thread's initial posting, this appeared to mark uncertainty and an attempt to move from one state to another. The shift from using 'we' to refer to individual communities, or to groupings within those individual communities, to using 'we' to refer to one large community proved to be a difficult move. The Schommunity used the pronoun in a seemingly wide sense, but examples such as 'could we not have a gaudi style cathedral instead of a gothic one?' implied that the first person address referred to those actively engaged in the debate – members of the original Schommunity and 1USTeen. In fact, of the 17 members of the US community who authored posts or who were credited as co-authors of proposals or evaluations in the thread, only 1USTeen used 'we' to include himself and the Schommunity.

The two communities employed collective ties between posts in very different ways. The US community used a formulaic structure for evaluations, linking their posts – however widely spaced in time – by the use of the headings 'strengths', 'weaknesses' and 'suggestions'. However, only three members of the US community built constructive ties linking their posts with those of the Schommunity. This prompted a shift in the behaviour of Schommunity members – they stopped replying to the formulaic project proposals and evaluations, although they still clearly read such postings and made reference to them.

The different registers used by the two communities thus limited communication between the two and reduced the chances that they would unite as one community. This was particularly marked when it came to the issue of authority and community norms. Within this thread, members of the Schommunity challenged both UK and US staff and engaged in detailed debate about Schommunity norms and standards. Three members of the US community took part in this debate *(although not in the direct challenges to staff)*. However, the register of formal schooling is not designed for the negotiation of norms, authority and standards and there was no apparent shift in lesson planning or assessment, even when the grading of 1USTeen was raised as an issue and alternative assessment methods were suggested. The use of this educational register thus made it almost impossible for the two communities to unite. The Schommunity did not have the option of volunteering for coursework and assessment at a school they did not attend; the US teenagers could only adhere to Schommunity norms if they were willing to jeopardise their schoolwork and grades.

In the case of trade, cohesive ties greatly increased both the possibilities for exchange and the resources available. At the beginning of the thread the proffered resources included information sources, time and digital resources *(recorded music)*. Without cohesive ties linking the communications of the two communities, these resources could not be accepted and they were no longer offered. However, when there were cohesive ties between postings, the dialogue in itself formed a valuable resource that brought together ideas, extensions to those ideas, challenges, counter challenges, questions, explorations and beliefs. The tools available in the forum, particularly the option for clearly delineated quotation, allowed community members to tie posts tightly together, creating a braiding and patterning of ideas that combined to form a complex multi-authored narrative.

Although an absence of cohesive ties and large disparities in register proved limiting and troublesome for the community, smaller disparities proved more fruitful as community members worked to establish coherence together. The need to consider and explain

the ‘Schome ethos’, the meanings of the ‘Japanese Garden’, and the reasons why cathedrals and Hawaiian Shirts could be interpreted both as religious artefacts and as sources of humour, stimulated an interconnected series of rich and complex learning discussions.

The analysis presented here focuses on the interaction of just two learning communities, but it has wider implications. Each community has its own practices around spirit, trust, trade and art, which must be renegotiated when it joins another community. Attention to register and cohesive ties offers ways of identifying and avoiding communication problems and also offers ways of increasing a community’s cohesion and its potential for knowledge building.

Conclusion

The shift from networked learning communities to single learning community is difficult to negotiate. Cohesive ties and register are tools that can be used to develop a coherent community narrative by bringing together the dialogue of separate communities and linking the contributions of diverse contributors in order to develop a coherent narrative. A shared register and cohesive ties between communications support the development not only of understanding but also of shared organisational structure, standards, goals, art and history. Without cohesive ties, effective communication and negotiation are limited and differences are difficult to resolve.

A shared register and cohesive ties also enable individuals to offer resources and services, and to take up others on their offers. These tools also have an important generative role in supporting and structuring the dialogue that resources learning and enables the co-construction of knowledge. This role is enhanced in an online setting by tools that allow the creation and utilization of cohesive ties, including tools for numbering or bulleting separate arguments, the creation of clearly delineated and referenced quotation, and easily accessible permanent records of communication.

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Practice, context, dialogue: using automated conversational agents to extend the reach and depth of learning activities in immersive worlds

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Abstract

This paper explores learning and teaching approaches to the use of virtual worlds in Higher Education and describes their applications and practical implementation, with particular emphasis on the use of the virtual world Second Life® to simulate professional practice activities. The paper also presents a number of practical challenges encountered by running those simulations and discusses the advantages of utilising automated avatars to counter those challenges and enhance the learning experience.

Learning in virtual worlds

Virtual worlds are three-dimensional representations of environments, either realistic or imaginary, where users can participate in a variety of ways from game play to social interaction. Users of virtual worlds create a virtual self, an avatar, which represents them within the displayed environment. Avatars are very customisable and users can alter many of their characteristics either by designing them or by purchasing items and scripts that can alter the appearance and behaviour of the avatar. Avatars very often resemble humans, but can also be animals, robots, objects or machines. Communication between users within a virtual world may be accomplished by using textual chat, avatar movements and animations, synchronous voice exchanges, or a combination of these methods. Usually virtual worlds operate as real-time environments where all the participants observe the same events occurring, experience them simultaneously and are able to see other users' avatars present in their virtual world vicinity at the same time. Some virtual worlds allow users to affect, alter or build their surroundings. These actions can be observed by other users in real-time, and can be accomplished collaboratively.

In sum, virtual worlds are feature-rich virtual environments with interaction paradigms similar to those of the real world, due to their three-dimensional representation and the embodiment of their users via their avatars. This paradigm familiarity confers virtual worlds unique learning potential amongst learning technologies as real life scenarios can be replicated within them with a range of variables affecting them. Such a context makes the elements of the virtual experience immediately applicable to real life at a cognitive level as the paradigm is so familiar: individuals choose to carry out certain actions and those actions have consequences which can have a positive, neutral or negative effect. Significant learning opportunities can be honed by exposing learners to that causality and encourage them to reflect upon the consequences of their actions.

However, it must be noted that using virtual worlds in a traditional higher education setting presents significant logistical challenges and resource support implications. The majority of virtual worlds are accessed via their client applications (software) developed by the companies that have created and own those worlds. The specialist virtual worlds' client software tends to use connections and online channels (ports) that are not required for standard Internet access. University networks are

often configured to block those ports as a security measure against malicious Internet traffic. Furthermore, virtual worlds are visually rich three-dimensional environments, and their client software requires computer equipment with above average processing capabilities for data and graphics. Therefore, deciding to use a virtual world to carry out learning activities with a cohort of students often requires forward logistical planning and investment, in order to be able to provide staff and students with adequate equipment. This planning would be in addition to any development of the learning activities and training required for members of staff who will be supporting students or taking part in the activities in an active capacity

Taking into consideration the challenges described above but also bearing in mind the learning potential that virtual worlds can offer as discussed previously, it becomes paramount to discern between uses of the virtual worlds that would merely replicate learning experiences that could be easily achieved by other means (using other, more standard learning technologies) and uses that provide unique experiences and opportunities (that could not be easily achieved without the use of a virtual world). One such use is the deployment of learning simulations in virtual worlds, where staff and students role-play different roles in professional practice situations. These are simulations that would be difficult, impractical, impossible or unethical to recreate in any other way for the students as a participative learning event.

Learning simulations in the virtual world of Second Life®

There are many examples of documented educational simulations that have been developed at different institutions across a variety of fields of study, such as Built Environment *(Nikolic et al, 2010)*, Occupational Therapy *(Brown and Williams, 2009)*, Epidemiology *(Hsieh et al, 2009, Neulight et al, 2007)*, Medicine *(Botezatu et al, 2010)*, Legal Ethics *(Schrag, 2009)*, Engineering *(Babich and Mavrommatis, 2009)* and Management *(Gurley et al, 2010)* to name but a few.

At the University of the West of England *(UWE)* we have devised and are developing a wide-ranging initiative called Simulations in Higher Education *(SHE)*, which aims to be a focus for the development of learning simulations across the university and their integration into different curriculum areas. Many students at UWE will go on to pursue careers in the professions such as law, engineering, nursing, social work and architecture. The simulations are aimed at enabling students to put classroom theory into practice in a safe and realistic environment. In this way they can develop tacit professional skills and gain essential experience before being part of similar situations in their future real-life workplace

There are a number of projects under development within the SHE initiative covering a range of subjects and scenarios that utilise the virtual world of Second Life®

- an accident investigation in a warehouse *(Environmental Health)*;
- a risk assessment scenario at a leisure boats hire premises *(Environmental Health)*;
- a food poisoning outbreak at a children's nursery *(Environmental Health)*;
- a business ethics scenario at the boardroom of a corporation *(Business Management)*;
- a set of counselling and consultation premises *(Psychology)*;
- a challenging social environment *(Criminology)*.

These simulations are designed as systems that are complex combinations of people, the activities they undertake and the premises, equipment or materials they come into contact with. These complex human system simulations can provide valuable learning experiences where the emphasis is not on the individual performance of the students taking part, but their exposure to different problems and their ability to critically evaluate their actions and consequences.

Second Life® is one of the virtual worlds that have attracted significant media attention and that many educators from the tertiary sector

are experimenting with. It was created and has been run by the company Linden Lab® since June 2003 and can be accessed via freely downloadable client software. Second Life® has over nineteen million registered users and, in that respect, is one of the largest virtual worlds used by adults. It is interesting to note, though, that the largest number of virtual worlds have been created for users between the ages of eight to twenty and that just one of those worlds has over one hundred and thirty-five million members *(Mitham, 2009)*. The world of Second Life® is a geographically large, customisable environment with access controls and community tools. Most significantly, it allows users to manipulate and build their own environment using inert components or user programmed interactive scripts contained within objects. This open-ended and extremely customisable world has for the last few years been attracting considerable interest from universities and other education and training providers. To date hundreds of universities and other organizations have some kind of project or presence based within the Second Life® platform aimed at education, training or simulation *(Linden Research, 2009)*.

Practice in context

One of the main advantages of using learning simulations is that one no longer needs to spend time describing the events *(Slotte and Herbert, 2008)*. Events can be shown in great detail, quickly and easily, using a simulation. Staff time can then be devoted to the creation of rich information sources that enhance a realistic and reusable scenario. The simulations can be deployed any number of times to different cohorts of students. The different scenarios may be logged as a series of events triggered by the users' actions or communication exchanges. These can be played back fully or partially to illustrate any teaching points.

This information richness can lead to a compelling learning experience for individuals who have access to virtual simulation as a training method and as a means to the development of their professional skills *(Hwang et al, 2009)*. There is increasing consensus amongst education users of virtual worlds that virtual simulations offer learning experiences that are different and complementary to more traditional methods and, indeed, for certain types of activity may offer an extremely cost effective and successful way to providing training.

One of the key aims of this type of learning simulations is to develop students' understanding of the interplay between knowledge, skills and values in their future professional context. Taking part in the simulation enables students to experience and reflect critically on the problems and uncertainties of the 'real' world of work and allows them to observe those issues from different perspectives *(professional, client, patient, etc.)*. These simulations are not simply examples of professional practice, rather they are a holistic programme that aims to bridge the gap between academic and professional knowledge by integrating skills and professional values. The simulations give context and meaning to academic subjects by enabling students to synthesise theory with their own experience; it informs students' views of their future professions and the contexts in which they operate. These learning simulations aspire to help to consolidate and extend what the students have been learning during the course of their studies in a number of ways:

Applied theory

It gives an insight into and depth of understanding of the theoretical field of their studies by enabling students to develop, apply and extend their academic knowledge and reasoning skills through analysis and problem solving. Students are able to contextualise their knowledge, and discover the relevance and applicability of that knowledge in a practical situation.

Skills development

Simulation allows students to practise and develop important skills. These can include oral communication, interviewing, research, analysis, fact finding, data handling, management, writing reports, negotiation, group work and critical reflection.

Interdisciplinarity

The content of simulations very often has to draw on other disciplines. This emphasises psychological, linguistic and commercial professional dimensions. Students are therefore encouraged to view their work from a number of critical perspectives.

Collaboration

Simulation acknowledges the power of cooperation: both for achieving goals and as an instrument for learning *(developing cognitive abilities and building confidence)*. Students can help each other by discussing issues, reviewing actions in their groups and giving peer feedback *(Luctkar-Flude et al, 2010)*.

Deep learning

Simulation encourages deep learning in that the problems students are required to solve are multi-faceted. A simulation does not present the student with a singular problem with one correct answer. It requires participants to interact with each other, to investigate their environment; the emphasis being on the process, rather than on a solution-focussed outcome.

The dynamic nature of professional problems

Simulation introduces the human element into the application of theories. Students learn to perceive other participants in the simulation as people, not problems, and have to deal with the uncertainties and ambiguity of human behaviour.

Professionalism

Simulation seeks to demonstrate that professional practice does not simply rely on technical competence *(Barton, McKellar and Maharg, 2007)*. It stresses the ethical and social responsibility of individuals, alongside their personal qualities, as key characteristics of professional capability.

Acknowledging the affective

Professionalism combines the cognitive and the affective: ethics, values, attitudes, skills, propositional knowledge, experience and world views. Decisions made in the real world of practice have potential emotional impact. Simulation has the advantage of allowing participants to experiment and take risks in a virtual practice world. The situations are not as emotionally charged as those in real life, yet students can experience some level of emotional engagement. Furthermore, students gain positive emotional experiences from solving complex and challenging human problems and this in turn improves confidence.

Authenticity

Simulation can expose students to the complexity, randomness, unpredictability and spontaneity of real-life professional practice *(Barab, Squire and Dueber, 2000)*. They can experience the flow of the simulation; the direction it takes depending on the actions of the participants and the points at which it falters or comes together. Students have to work collaboratively and make decisions which may or may not be right in conditions of uncertainty; and they have to resolve problems which may have arisen as a consequence of poor decision-making.

Limiting nature of traditional role-play

Aldrich defines a simulation as a 'rigorously structured scenario carefully designed to develop specific competencies that can be directly transferred into the real world' *(Aldrich, 2009)*. The learning simulations that we are developing are complex in nature as described previously in this paper. This complexity stems directly from our ambition to recreate realistic scenarios where students can develop their professional practice. Realistic situations of professional interaction require a number of different characters who drive different aspects of the interactions and who bring different perspectives and values to the particular setting we are aiming to expose the students to. This desired

complexity presents two main drawbacks to the deployment and effectiveness of the simulations: staff time required and ephemerality of the interactions. Staff time available to role-play the different characters is limited and it often proves difficult to organise a simulation session as the complete staff group has to be available at the same time. This reduces the flexibility of the simulation as a virtual resource as its scheduling opportunities are limited. The ephemerality of the interactions is also a consequence of having to rely on character role-playing as part of the simulations. The exchanges with the role-played character can be recorded, but the experience itself is transient: the learner is not able to retake or to re-enact a conversation having reflected on a first attempt. Therefore the learning opportunities become constrained by practicalities – these are the practicalities of real life rather than the affordances of the virtual medium. This is an aspect of the simulations where the learning process could be enhanced by departing from realism; in real life we are not able to re-run a conversation, but for learning purposes this can be desirable as the students can apply what they have learnt from their first experience and explore the consequences of using a different approach or formulating their questions/responses differently.

Automating role-play

We are investigating ways in which we can overcome the drawbacks of staff role-play as explained above. The field of computer games has traditionally overcome this issue by utilising non-player characters *(NPCs)*. These characters are automated and not controlled by a human participant. The use of NCPs has the potential to significantly enhance a learning simulation as staff contribution becomes more manageable. A given situation in a simulation will have a number of characters. Some of those can be made to have more standard characteristics and behaviour and be an NCP, and those that require a more nuanced personality can be role-played by a member of staff. This rationalisation of roles can significantly increase the flexibility of the resource as scheduling complexity decreases. It also affords greater design opportunities as the simulation can be enhanced by deploying more NCPs and by making them available to students even when no member of staff is available to role-play. NCPs standardise the learning experience as their output is scripted and this introduces a desired element of parity of experience for all student participants. A further advantage of the use of NCPs is the opportunity to log interactions and conversations and use these logs as the basis for feedback to be given to students about the quality of their participation in the simulation. The logs can also be utilised as information to be used in the refining of the NCPs for future iterations of the simulation.

Extending the learning experience beyond the virtual world

Another limiting factor that we have uncovered while developing and piloting learning simulations in virtual worlds is the boundaries of the virtual world itself. As mentioned above there are aspects of the learning experience that can be enhanced by departing from realism, e.g. ability to re-run conversations with NCPs. This approach also has the potential to provide further support to students who are not English native speakers. Therefore the development of NCPs that the user can interact with both within the virtual world, and outside of it via the Internet holds significant potential for educationalists. This kind of NCP deployment would provide all the benefits we have previously identified for in-world use and it would also enable us to extend the learning experience beyond the virtual world and the simulation environment itself, increasing its efficacy *(Shih et al, 2010)*, providing additional support to students and allowing them to delve deeper into the information that the NCPs have been designed to provide in each case.

Multiplatform automated conversational agents

The main challenge of the application of NPCs to a learning simulation lies in the development of that automation and the extent to which it can provide a realistic alternative to a role-played character. At the University of the West of England we are developing a project under the SHE initiative *(described earlier in this paper)* aimed at providing information and support to students, with the secondary objective of utilising the concept to support the delivery of learning

simulations. The project is called Simulations in Higher Education Linguistic Localised Avatar *(SHELLA)*. Its main objective is to harness the reach and effect of information already available online by developing an interaction method *(Benyon, 2010 and Rogers et al, 2011)* that will mediate the communication process in a more natural way and that will help overcome communication barriers such as cultural and linguistic differences.

The project variant that will be used to support learning simulations will deploy customised and prefabricated information banks. Students will be able to conduct interviews and investigations in order to extract particular information that forms part of an immersive learning simulation taking place mainly in the virtual world Second Life®. An information bank can be developed per individual automated character that will form part of a given learning simulation. The information bank is connected to a customised Second Life® avatar account, so that students participating in the simulation can interact with it in order to obtain relevant information as part of their simulation brief. The system presents the added flexibility of being accessible via the Internet as conversational agents on a browser-based interface. Variants of the interface can work on a range of devices *(smartphones, tablets and computers)*

We have already achieved a stable set of prototypes that are handling dynamic multi-language input via the browser-based interface *(Figure 1 and Figure 2)* and that can respond to users' questions utilising Artificial Intelligence Mark-up Language *(AIML)* algorithms.



Figure 1 Minimal mobile browser interface and Smartphone browser interface of the

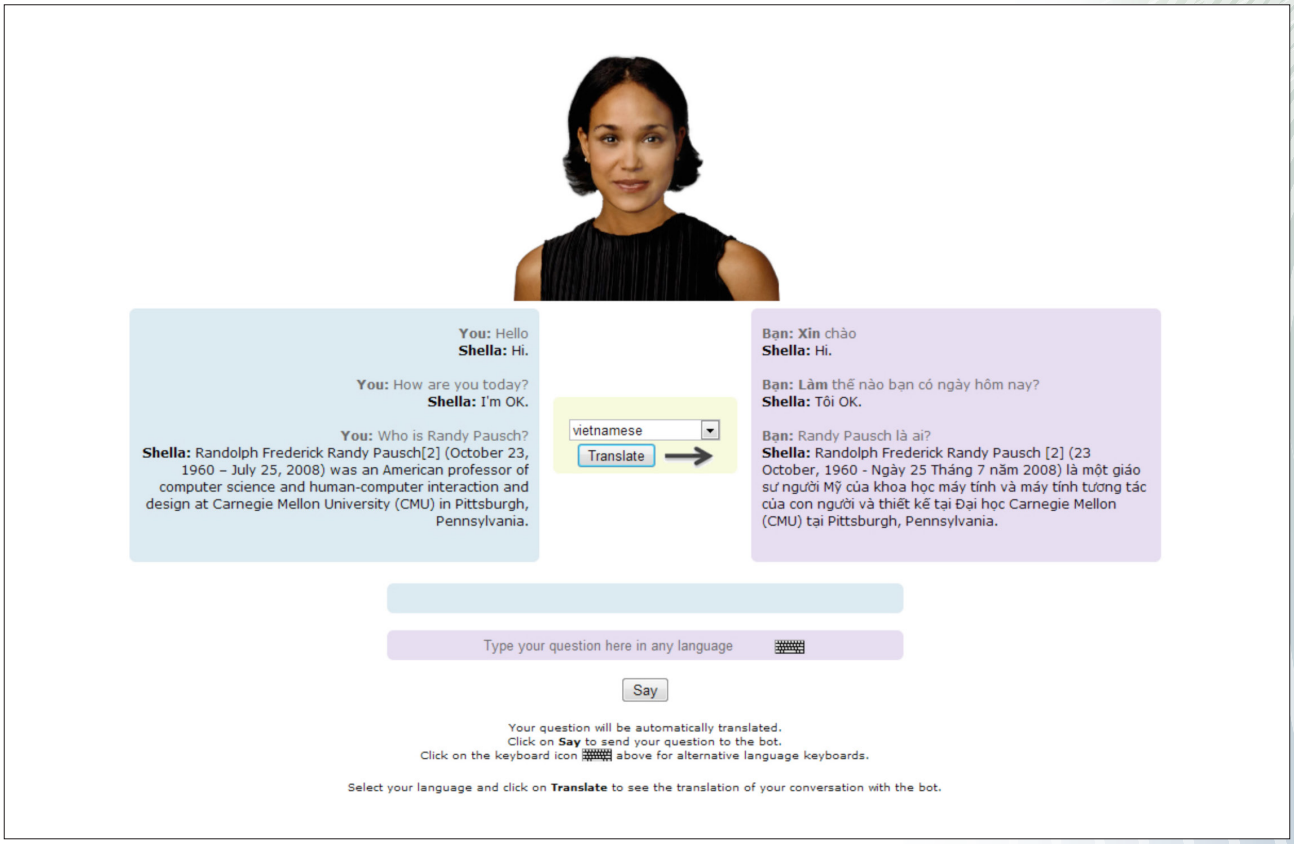


Figure 2 Full browser interface of the SHELLA project displaying a conversation where the user has asked some questions, has received answers to them and their translation into the user's language of choice.



Figure 3

Screen capture of a conversation in Second Life® with Shella Aura, the automated avatar connected to the SHELLA information bank.

The project development has been fully documented and was presented as an academic paper at the World Conference on Educational Media and Technology ED-MEDIA in June 2011 *(Frutos-Perez, 2011)*. As already stated AIML was an obvious candidate to provide the structural underpinning of the conversational elements of the system *(Dybala 2010)*, as it would allow for the processing of natural language interaction and a variety of response arrays, referrals and randomization. Different products already developed by third party providers were identified as being able to support different sections of the functional architecture: Discourse® *(Daden Limited)*, Sitepal® *(Oddcast Inc)*, Translate API *(Google Inc)*, Yeast Templates *(University of La Rioja)* and Virtual Keyboard Interface *(GreyWyvern Inc)*. The Second Life® interface with the information bank *(Figure 3)* also uses Daden Limited's BotIF® product, which provides further functionality such as automated avatar geographical awareness, response to presence of other avatars, gestures and movements that can be triggered by particular verbal prompts.

We are now confident that we will be able to deploy these conversational agents as NPCs in learning simulations. The possibilities in terms of learning design development are of considerable interest. One planned development will be a character who suffers from a particular personality disorder. The answers that the NCP will give to certain questions and verbal prompts will contain traits *(as indicated by our colleagues in the Department of Psychology at UWE)* that will give an indication of the particular disorder. Psychology students will be asked to interview the NCP and write a report based on their consultation with a diagnosis *(evidenced by the traits they identify during the conversation)* and a suggested treatment. Another planned development will be an NCP who is a witness of an industrial accident that has taken place in a warehouse in Second Life®. Environmental Health students acting as health and safety inspectors will interview the NCP and try to elicit key information that will allow them to understand how the accident unfolded.

Conclusion

The use of virtual worlds holds great educational potential for the development of learning simulations. Students' development can greatly benefit from participating in simulations as it enables them to start building their professional skills, and provides them with a safe environment where they can put theory into practice and can then reflect on the effectiveness of how they applied these theories. Learning simulations can be very taxing in terms of staff time and scheduling arrangements and can become inflexible with the addition of too many role-played characters. Automated conversational agents can be used to counter these issues and their development can enable us to devise deeper learning experiences that can be run with minimal staff input at the point of delivery. There are several areas that need to be further evidenced to ascertain the true educational value of these conceptual developments, such as students' views on the experience of interviewing the NCPs, tutors' perception of the effectiveness of the resources, quantitative usage data and qualitative analysis of the interactions between students and NCPs.

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Conducting Text-Based Interviews in Virtual Worlds

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Abstract

Interviews are a staple data collection tool in social science research and in recent decades have been increasingly formalised and systematised. However, due to the specific affordances and constraints of virtual worlds, researchers cannot simply replicate traditional interview techniques in virtual worlds without careful consideration of the specific features of the technology. While in-world interviews provide both opportunities and obstacles to researchers, there has been little reported on these in the literature. To begin to address this, this paper explores the opportunities, constraints, techniques and implications of conducting text-based interviews in-world. Following a structured reflection on their own experience as interviewer and interviewee, the authors analysed interviews conducted as part of several qualitative studies exploring the educational use of virtual worlds. In total 20 individual and 10 group interviews were analysed to explore the effect of the interview medium. The discussion highlights the key findings which should be considered by researchers wishing to conduct text-based interviews in virtual worlds and aims to stimulate discussion on conducting interviews in virtual worlds.

Introduction

While educators are challenged by the educational affordances and constraints of virtual worlds *(Jarmon, 2009)*, researchers also need to consider both the opportunities and obstacles to conducting educational research in virtual worlds *(Moschini, 2008)*. Within qualitative methodologies interviews provide researchers with a particularly powerful research tool as a means to get 'inside a person's head' *(Tuckman, 1994)* in order to understand their subjective experience. With an increasing literature on educational research in virtual worlds, it is perhaps surprising that there is not a relative increase in the number of reported interviews conducted in-world. Whether this is due to methodological or contextual restrictions is unclear. However with an improved understanding of the potential advantages and appropriate techniques a greater number of researchers may begin to engage in this style of interview.

The work in this paper presents an initial step in combining practitioner experience and data to develop recommendations for researchers conducting interviews in virtual worlds. The aim is to stimulate discussion amongst the research community towards developing best practice for conducting interviews in-world. To achieve this we present the current literature on traditional interview techniques and explore the use of interviews in research on the educational use of virtual worlds. In the method section we present our approach to combining reflections on experience and analysis of data from interviews conducted in-world across three interview mediums: face-to-face, VOIP and text. The findings in the paper focus on one-to-one and group text-based interviews. While our data and experience of conducting interviews are based in the virtual world of Second Life, the findings are equally relevant to conducting interviews in other virtual worlds as the paper focuses on the interview medium. Following presentation of the findings, the discussion focuses on opportunities, constraints, techniques and some of the implications of conducting text-based interviews in virtual worlds, many of which are pertinent to conducting VOIP in-world interviews.

Traditional interviews: Purpose, type, form, medium and location

There are five characterising features of interviews: purpose, type, form, medium and location. This section briefly presents each feature and is followed by an exploration of these characteristics within the current literature on educational research in virtual worlds.

Within a research study there are three distinct purposes for choosing to conduct interviews *(Cohen, Manion, & Morrison, 2000)*. Firstly, and most commonly, the purpose of a research interview can be to collect information pertinent to the broader objectives of the study. Secondly the interview purpose can be to validate, refute or amend hypotheses. Finally the research interview can be used in conjunction with other data collection instruments to develop nascent understandings or delve further into emergent aspects of the phenomena under study.

The purpose of the interview then guides the selection of the interview type. The literature in this area presents differing views on the number of types of interviews *(Cohen, et al., 2000)*, however the most common typology is that arranged along the continuum of structure, from the structured *(or standardised)* interview to the unstructured or open interview relies solely on open questions allowing the participant to form their own response *(Creswell, 2002; Cohen, Manion & Morrison, 2007)*.

One-to-one interviews are most prominent form of interviews *(Kvale & Brinkmann, 2009)* and are popular in educational research *(Creswell, 2002)*. Although time consuming, one-to-one interview allows the researcher to gather a personal perspective from the participant without fear of ridicule or the impact of group dynamics. Group interviews can also gather information from individual participants as well as collecting the shared understanding of multiple participants *(Creswell, 2002)*. As such it can seen to represent aspects of a knowledge construction event *(Kvale & Brinkmann, 2009)*.

Whether conducting one-to-one or group interviews, there are several communication mediums through which the interview can take place. Traditionally interviews are conducted face-to-face or in some cases via telephone, however advances in computer mediated communication tools and environments have opened up the possibility of conducting interviews through synchronous and asynchronous text-based communication through tools such as electronic mail and instant messaging. Alternative voice-based communication tools include voice over IP *(VOIP)* and video conferencing.

The final feature to be considered is that of location. As previously mentioned, interviews traditionally take place face-to-face with both interviewer and interviewee in the same location. However telephone interviews provided an opportunity for interviewer and interviewee to be at a distance from one another. Whether this takes place in the research setting *(in context)*, such as a classroom or out of context in a private office will depend on the purpose of the interview. Thus the traditional interview location may be face-to-face or at distance and in context or out of context. In addition virtual worlds provide researchers with another choice, whether to conduct interviews in-world or out-of-world.

Virtual world interviews

Unlike other online technologies, virtual worlds provide researchers with a range of opportunities to conduct interviews afforded through a combination of features, including the use of avatars and a variety of communication tools. For example, Minocha, Tran & Reeves *(2010)* identified potential participants through serendipitous encounters with their avatars in selected locations throughout Second Life and thus selected participants based on their avatar profile information. Having selected a participant they used in-world communication tools to initiate a conversation and invited them to participate in an interview there and then or a later time.

Moschini *(2008)* notes that learning experiences which take place in a virtual world may be evaluated using real-world, online and in-world tools. Hew & Cheung's *(2010)* review of the literature on educational research in 2008 identified only five studies that reported the use of interviews, none of which reported using virtual worlds to conduct the interviews. Since 2008 there has been a significant increase in the number of articles published on the use of virtual worlds in education and with that an increase in the number of studies using interviews. In a review of 208 articles published or made available as pre-print by July 2011, on educational research in virtual worlds, 54 described the use of interviews for data collection. Both face-to-face and in-world interviews were reported with equal frequency and of those conducted in-world, both text and VOIP were used. However it is notable that over half of the reported in-world interviews did not state whether text or VOIP were used.

While there has been an increase in the use of virtual worlds to conduct interviews across research fields, there is limited existing literature on techniques, opportunities, implications and importantly the constraints of interviewing in in-world. Within educational research, Kirrriemuir *(2007)* used in-world text interviews as follow-up to questionnaires. He found that these interviews provided little additional information, however he noted that this was likely to be constrained by his then lack of experience of interviewing in-world, technical problems and the long time to type questions and responses. Time was also a constraint identified by Vasileiou and Paraskeva *(2010)*, who found that conducting the same structured interview in-world took almost twice as long by comparison to a phone interview.

Based on the literature reviewed, Minocha et al. *(2010)* provide the only notable description and advice on conducting interviews in virtual worlds, based on their experience of conducting interviews in two Second Life research projects. Logistics such as maximum length of an interview, codes of practice, ethics, researcher identity and interview locations as well as some discussion on the use of face-to-face versus voice are presented.

It is important to note that in addition to the consideration of the opportunities, constraints, specific techniques and implications of conducting interviews in-world, there are additional ethical concerns that may need to be addressed when conducting interviews in-world. These include whether to use voice or text using public or private communication channels *(Minocha et al., 2010)*, informed consent, privacy protection and the identity of the participant *(Girvan & Savage, in press)*.

Method

The dearth of literature on conducting interviews in virtual worlds has prompted us to consider interview techniques, opportunities, implications and the constraints of conducting interviews in-world, about educational experiences in virtual worlds. While this paper specifically focuses on conducting text-based interviews, this forms part of a wider research project into conducting interviews both in-world and face-to-face. Since 2008 the authors have conducted qualitative research into educational learning experiences in the virtual world Second Life and have developed their approaches to conducting interviews in-world across mediums. The purpose and type of each interview has consistently been phenomenological and open, focusing on the participants' experience in the virtual world. Both group and one-to-one interviews have been conducted across the mediums of face-to-face, VOIP and text.

Rather than simply describe our approach to interviewing, this paper aims to highlight several key points for discussion in the wider virtual world research community. As such we collated the interview data from four learning experiences: an introduction to Second Life, an in-world introduction to the technology for teaching and learning; North-South Interdependence *(Girvan & Savage, 2010)*, part of a development education learning milieu; EPIC, exploring the novel in context; and SLurtles, an introduction to programming and constructionism *(Girvan, Tangney & Savage, 2011)*. Some of which have taken place several times over the past few years.

Prior to analysis, we participated in a 2.5 hour joint reflection session on conducting these interviews as well as our experience of being an interviewee in 6 one-to-one in-world text interviews. Following analysis of the reflection, a priori codes were identified with which to analyse the interview data, whilst remaining open to emergent codes. Finally a quantitative analysis of the interviews was conducted to explore turn-taking, coding and duration.

Findings

As this paper focuses on conducting text-based interviews in-world, the findings of the reflection session and data analysis which relate to both one-to-one and group text-based interviews are presented here. While there is some overlap between one-to-one and group-based interviews, there were some aspects that only emerged in the group-based interviews, highlighted in the section on group interviews. Each section begins by presenting the findings on the strategies used by the researchers, the interview experience and finally data collection.

Text-based interviews

When conducting research in-world, a number of alternative researcher strategies need to be employed as interviewer and interviewee*(s)* are unable to see each other, and thus non-verbal cues are lost. This is particularly true in text-based interviews when they are also unable to hear each other. While in-world tools such as Second Life gestures and animations may be used, we have found them to be both distracting to participants and sometimes go unnoticed. Instead we use emoticons and emotes. For example, typing *"/me"* followed by *"nods"* will be displayed as *"Sleepy Littlething nods"*. This provides the interviewer with an opportunity to add a form of non-verbal encouragement and demonstrates that the interviewer is still engaged. There was evidence that these techniques were also used by participants in group interviews who had familiarity with these gestures.

Another approach used to demonstrate that the interviewer is engaged is to comment directly on what the interviewee has said, for example *"That's an interesting point, do you think affected how you worked?"*

From our experience as research participants in one-to-one text-based interviews we have found that silence, although a traditional interview tool, can be difficult to use well in this medium. For example in our own interviews we would wait whilst we observed the participant's typing animations or in IM saw messages such as 'X is typing'. However as participants, having given a detailed answer to a question our interviewer has remained silent with no typing animation. This has given us the sense of great unease, wondering whether the interviewer has crashed, is away from their computer or is otherwise not engaged in what we had to say.

Whilst the interviewer accidentally interrupted participants across all three mediums, the data showed that interviewer interruptions most commonly occurred in text-based interviews in both one-to-one and group settings. This was anticipated in the reflection session and was attributed to the lack of non-verbal cues, as it is not possible to anticipate if someone is about to type.

Text-based interviews can provide a number of advantages for researchers. During the reflection session we noted that interviews provide an opportunity to scroll through the text allowing the interviewer to refresh their memories of comments made earlier by participants. In addition notes can be made of questions to ask or ideas to follow-up from other sources.

Participants may prefer to use text if they have participated in a text-based learning activity or wish to protect their identity *(this point is discussed in detail by Minocha et al., 2010)*. However not all participants may be comfortable using text-based communication tools and may find the medium 'slow'. It may also discourage learners from participating if they have a perceived language barrier, for example non-native speakers. In addition, during the interviews there was evidence of misreading questions. In one interview a participant began answering a different question, stating *"oops, didn't read the question"*.

While technical problems may be more likely in virtual world interviews, text-based interviews provide researchers with additional opportunities to collect data. Participants may be asked to record their text chat using the in-world tools, or to copy and paste from the virtual world and email to the researcher. Chat loggers may also be used as a back-up with permission. In addition, the researcher can save a significant amount of time overall by comparison to audio recorded interviews, as text provides the researcher with a ready-made transcript.

Quantitative analysis of the data found that while both one-to-one, face-to-face and VOIP interviews resulted in a similar number of words elicited from participants, text-based interviews resulted in significantly less words. For example a 27 minute SLurtle face-to-face interview and 28 minute VOIP interview resulted in 3,705 and 3,822 words respectively in response to interview questions. By comparison a 28 minute text-based EPIC interview resulted in 669 words from the interviewee.

Group specific

An important consideration for the researcher prior to conducting the interview, which emerged from the reflection session, was whether to use avatar names or real life names. While we agreed this would be dependent on the research context, we were uncertain what would happen in group interviews conducted in-world when the participants had previously met each other and the interviewer face-to-face. Both the EPIC and North-South learning experiences took place with participants that had met face-to-face in class for at least 3 months prior to the learning experience. It was found that avatar names were used exclusively in both of these interview contexts.

Both reflections and data suggest that gaining the attention of participants when they go off-topic is most difficult in group text interviews. In one example it took the researcher 2 minutes to regain the attention of the group and direct them on to the next question. Tactics included the use of capital letters e.g. *"NEXT QUESTION"* and persistent short messages. It was important in this context, especially when time is limited, for the researcher to remember that text-based communication is open to misinterpretation. For example while short messages can be used to gain attention they may also fill the screen which, in addition to gaining attention may be perceived as rude. In the case of the two minute attempt to gain the attention of the participants and to move them onto the next question, the interviewer took 50% of the lines of text and used short messages such as *"guys"*, *"if we may...."*, along with long utterances such as *"can I get us back to Second Life?"* and repeating the question.

In the reflection session we identified that during group text-based interviews participants had the greatest opportunity to become 'invisible' whilst present. By this we mean that whilst their avatar may be present on screen the person controlling the avatar may: be experiencing technical problems; be distracted by something outside of the virtual world; or wish to avoid a particular question. There was evidence in one of the group text-based interviews of one participant stating *"brb" (be right back)* leaving the conversation for a few minutes and then announcing their return. However it is unknown how many participants may have been absent from any of the text or VOIP group interviews and for what reasons.

It was noted by participants in one of the Introduction to Second Life interviews that, as the participants had used Skype during the learning experience, they continued to have it open during the first five minutes of the 26 minute interview. This provided them with an opportunity to communicate with each other which the interviewer could not hear or record.

From the emergent codes there was evidence of participants in a group interview in-world, but importantly out of the original learning context, taking items from their inventory and placing them in the environment to 'refresh memories'. It is worth noting that this occurred in the North-South interviews only and may be related to the type of learning activity, as the North-South activity required learners to engage in a learning experience over two days in which they used and created objects, while EPIC and the Introduction to Second Life took place in one session with no requirement to create objects, although they did interact with objects in the environment.

Our reflections suggested that humour may be more prevalent during in-world interviews than face-to-face. Whilst there was evidence to suggest this from the data, it was least common in one-to-one interviews across mediums. Humour was most common in group-based text interviews, occurring in five out of eight interviews.

In seven of the eight group text-based interviews there was evidence of off-topic utterances from participants. This was contrary to our initial reflection which suggested that off-topic utterances would be least common in text-based interviews. The off-topic utterances were related to in-world distractions such as props and animations, for example an avatar drinking a Martini resulted in the other participants joking and sharing objects. The percentage of off-topic utterances in an interview averaged 9.39% across the seven interviews with 15.72% the highest.

Whilst it was clear in VOIP and face-to-face interview transcripts when one participant interrupted another, it was less clear in text-based interviews due to the length and number of utterances from individual participants. For example the average utterance length was 10 words, whilst the longest was 34. As a result whilst answering a question a participant would tend to use several short messages. If someone else was typing at the same time these utterances could appear to be interrupted by each other. In the reflection session we identified that as a result it was not always possible to know whether participants had finished their answer or whether they had become silent because a more dominant voice had moved the conversation away from the point they wished to make.

In our initial reflection session we also considered that in group text-based interview transcripts it would be more difficult to follow the flow of the conversations due to the short and overlapping utterances. As a result we suggested that it may be necessary to annotate text transcripts as soon as possible after the interview to clarify any sections that may be confusing at a later date.

Discussion

Opportunities

While face-to-face interviews are currently the dominant medium in the literature on educational research in virtual worlds, there are a number of advantages to conducting interviews in-world. This approach allows not only access to participants otherwise unavailable but provides opportunity for the interview to be conducted in the learning context allowing both interviewer and interviewee to identify, share and demonstrate objects and activities during the interview. This may also provide researchers with an opportunity to engage in a modified form of stimulated recall in which the researcher identifies a specific object in the environment and participants would be asked to describe their thought processes whilst engaging with it during the learning experience.

In addition to conducting the interviews in the research context, the findings show that text-based interviews also provide the interviewer with a number of opportunities unavailable in traditional face-to-face interviews, such as: back-up recordings created by participants; ready-made transcripts; and the opportunity to note-take and scroll through the interview transcript during the interview.

Constraints

While there are a number of opportunities that in-world interviewers can provide the researcher, there are also a number of constraints to be aware of. Text-based interviews can be perceived as slow, thus discouraging participation. We also found that in group-based text interviews it could be particularly difficult for the interviewer to gain the attention of participants when they began to go off-topic.

While some constraints can be difficult for the interviewer to work with, others may be turned into an advantage. For example, in group in-world interviews, participants may engage in back-channel conversations through local-chat, IM or, as found in one case, through VOIP. These conversations may be distracting to participants and result in a lack of

engagement with the interview. However it may be possible for an interviewer, with permission, to collect this as an additional data set.

There was evidence in both one-to-one and group interviews of participants taking a break from the interview. This was particularly problematic in group-based interviews whether text or VOIP, as they provided participants with an opportunity to become invisible whilst present, with the interviewer uncertain as to whether the participant is experiencing a technical problem, is listening to others or has left their computer.

Text based interviews can address the ethical concern of identity highlighted by Minocha et al. *(2010)*, as this medium does not project identifying features such as gender. However this raises an ethical concern, that of validating informed consent by verifying that the person giving consent is who they say they are, which is a responsibility of the researcher *(Girvan & Savage, in press)*. Despite the ethical concern, accepting unverified consent is common in online educational research *(Kanuka & Anderson 2007)*. Researchers willing to accept unverified consent therefore need to be aware that participants may misrepresent demographic information, particularly if they have an incentive to do so.

Techniques

Minocha et al. *(2010)* describe logistics such as maximum length of an interview, codes of practice, developing researcher identity and interview locations for conducting interviews in-world. In this section we focus on techniques to address some of the constraints and opportunities discussed, to support researchers whilst conducting interviews in-world.

To monitor whether participants are present at the computer or not, at the start of group interviews the researcher may indicate that any participant needing to leave the interview for any reason may do so, and should inform the researcher. Depending on the context this may be most appropriate via a private IM to the researcher. While this may not discourage participants from disengaging, it should encourage participants to acknowledge to the researcher that they have left and may thus be noted in transcript annotations.

Group text-based interviews were identified as the most likely to contain off-topic utterances and the most difficult to gain the attention of participants. While off-topic utterances such as sharing drinks between avatars may be useful to support group cohesion they can be distracting mid-interview. The researcher should therefore provide an opportunity for participants to engage in such activities prior to the interview, for example by offering them a virtual cup of tea. Tactics for gaining participants' attention are highlighted in the findings.

When note-taking or scrolling through text during the interview, it is important to maintain engagement with the participant. This is particularly important due to the lack of non-verbal cues in-world and as such the interviewer needs to demonstrate engagement in what the participant is saying throughout the interview.

In both text and VOIP interviews non-verbal interactions and silence need careful consideration. While useful tools in traditional interviews, the in-world interviewer needs to be aware of how they can be used with both positive and negative effect. To replace non-verbal interactions interviewers can use visual actions such as gestures or animations or in text use emotes or short utterances. However it is important that these do not become a distraction to either the interviewer or the interviewee. From our experience and analysis of the data, we believe that interviewers should avoid using silence during in-world interviews as it may lead the participant to believe that the interviewer is disinterested or is experiencing technical problems. However participants still need to be given sufficient time to think and respond. Both IM and local-chat animations provide the researcher with cues that the interviewee is typing and so participants should be encouraged to turn the typing animation on if previously turned off.

Implications

The type of data collected may have additional implications for data analysis. The findings showed that text-based interviews resulted in significantly less words than VOIP and face-to-face interviews. There may be a number of questions that arise from this for data collection as well as analysis.

For example where a participant requests to take part in the interview through text rather than VOIP, is the data equally valid? Does it provide the same depth? Dependent on the data analysis approach, if text-based interviews provide less depth it may be worthwhile to conduct them first, analyse them for emergent codes and themes, then use VOIP or face-to-face interviews to explore these in depth. Similarly this may support the convergent interviewing technique.

While both text and VOIP interviews *(Knorr, Bronack, Switzer & Medford, 2011)* have been found to provide the researcher with an increase in efficiency, in-world interviews should not be chosen just because they are more efficient than face-to-face interviews. As with the selection of data collection tools, research question, availability of participants, participant preferences, depth and type of data analysis, etc all need to be considered.

Another implication of conducting interviews in-world is the role of the avatar. While Knorr et al. *(2011)* found during VOIP-based interviews that, despite prompting, there was no interaction between interviewer and interviewee avatars and participants did not initiate any movement, the participants involved in the study had no previous experience of virtual worlds. It is therefore unsurprising that one participant described *"Having a person standing in the middle of the virtual world with no real purpose was a little strange"*. To be able to effectively compare and conduct face-to-face and in-world interviews we believe it is necessary for both interviewer and interviewee to be comfortable with the medium. In-world this not only includes VOIP or text but also the avatar.

The current study found that avatar interactions occurred in both VOIP and text interviews, with participants sharing objects and moving around the environment. As a result the avatar is more than just an embodiment of the interviewer and participant*(s)* in a 3D environment but another communication mode and further research needs to be conducted to explore the impact of the avatar on the interview process.

Conclusion

Through practitioner reflection and analysis of interview data, this paper has explored the opportunities, constraints, techniques, and implications of conducting interviews in virtual worlds. As such a large area of potential study and the limited data analysed, this paper does not try to provide a definitive set of guidelines but rather highlights some of the key points that have emerged from our experience and analysis of the data. It is important to note that when conducting educational research, each study will be bound in a specific context and this context will influence the style of interview, through the purpose, type, form, medium and location.

The findings demonstrate that while reflecting on experience can be useful to provide recommendations to practitioners from practitioners, such reflections need to be underpinned by the data where possible. For example, in our reflections we suggested that humour would be more prevalent during in-world interviews. Whilst this was supported by the data, there was also data to show that one-to-one interviews across mediums provided little evidence of humour and that humour was most common in group text-based interviews. Our reflections also suggested that off-topic utterances would be least common in text-based interviews due to the perceived slowness of the medium, however the data revealed that most off-topic utterances came from group text-based interviews.

Beyond exploring such issues in-depth, this paper highlights a number of broader areas for future research into conducting in-world interviews, including: the use of stimulated recall; the role and effective use of avatars; unpublished utterances in group text; the validity of text versus VOIP interviews along with the implications of the data generated through both mediums, and conducting in versus out of context interviews in-world. Finally, there is a need to specifically examine in-world interviews from the perspective of the participant and the implications of medium, location and choice of data collection tools on the data analysis process.

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Cloud based content control for virtual worlds

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Abstract

This paper presents a communications and data model that supports cloud based control and management of interactive learning scenarios in Second Life. It describes an example and discusses the advantages for implementing applications and the potential for inter-institutional collaborative applications using remote hosting on cloud computing infrastructure.

Introduction – technological context

The concept of cloud computing is ill-defined, but a short-list of common features place most virtual world environments within a broad interpretation of its definition *(Boellstroff 2010)*. Although the cloud computing term 'Software as a Service' is normally used in a business context *(when an application used by a business is hosted by a separate service provider)* it better describes access to virtual worlds than more generic terms such as 'internet application' or 'client server'. Most users of Second Life do not know or care how the computing resources are organised to support the application.

The current implementation for Second Life has a one-to-one mapping between the region, the virtual simulation and the processing hardware but, when working well, this is hidden from the user. Similarly a user navigating an OpenSim *(OpenSim 2011)* virtual world may be aware of differences between regions but is not concerned with the particular set up of the distributed physical computing resources. However, more recent designs, such as the Reaction Grid *(2009)* use a virtualised computing resource to support the simulation which is a significant step towards enabling a truly cloud based implantation. A reasonable aim for virtual worlds is that that users should be concerned about the activities and content rather than the technical infrastructure – the more the underlying technology can be run as a ubiquitous resource, the more this is likely to be satisfied.

Advances in information and communication technologies *(ICT)* typically follow a model *(Rogers 2003)* where a highly specialised application is progressively made more generic and available to a wider audience. The internet is a good example where a technology, initially developed for defence found, applications in education and science, then spawned a number of proprietary closed worlds before establishing a generic and ubiquitous resource supported by open, international standards. The underlying motivation for this research is to help make educational applications in virtual worlds less reliant on a deep knowledge of proprietary software and in-world scripting. Open standards and generic tools will help the process of innovation diffusion to bring technology to a wide user base. Although only a small step, linking virtual worlds to simple cloud based resources may help this process.

The research group Gartner suggests that emerging technologies suffer a 'hype cycle' *(Fenn 2010)* where over inflated expectations are followed by a period of disillusionment before steady progress in made. Although public virtual worlds are currently in the 'trough of disillusionment' *(Hypergrid Business 2010)* this does not necessarily effect their longer term future. A similar 'hype cycle' *(Smith 2010)* for cloud computing puts this at the top of the cycle so we should expect increasing criticism

of the approach. After which development will continue at a pace driven by technical progress, commercial pressure and social acceptance. In the meantime examples of good practice and incremental improvements in reliability and usability are some of the ways in which a technology can haul itself out of the trough of disillusionment and onto the 'slope of enlightenment' and onto the 'plateau of productivity'.

New technology in a variety of devices is improving access to all 3D environments but until content creation becomes more accessible it will be hard to create enough good applications to attract developers of educational activities or users from the general population. The Hypergrid *(2010)* allows avatars to move between different virtual worlds that use the same OpenSim architecture. However, there are considerable obstacles to be overcome before a seamless 'grid of grids' allows unrestricted access to multiple virtual worlds and there is a long way to go before this technology becomes just another ubiquitous part of web and browser based technology. There is progress being made with standards *(Bell 2010)* and content creation where the use of generic 'off world' 3D graphics packages can allow uploading of models and textures to OpenSim and increasingly to Second Life *(Mesh 2011)*.

Commercial virtual worlds rely on proprietary software and both these and open source implementations need specialised knowledge and scripting skills which are beyond most users. A common solution to providing services to users without exposing the details of the underlying technology, is to insert a layer into the interaction model so that the user only sees a simplified version that is more tailored to their needs. The idea is to allow a greater number of educationalists to create and support their applications without having to rely on a small band of enthusiasts with highly specialised knowledge.

One particularly successful example of an interface to support educational activities is SLOODLE *(Sloodle 2011)*. This uses HTTP protocols to link between Second Life and Open Sim based virtual worlds and the Moodle *(Moodle 2011)* Virtual Learning Environment. In-world educational activities can be supported, recorded and presented within a web based application that allows greater access, more reliable data storage and non-synchronous interaction. This enables a more flexible use of the virtual world environment allowing off-line assessment rather than real time observation.

The availability of Virtual Worlds and their global access means that they lend themselves to sharing and re-use of resources. Tools such as SLOODLE, are openly available but each institution has to create and host their own installation. Issues of asset and space ownership combine to reinforce an 'Island' mentality *(literally in most cases)*, where people are welcome to visit but greater collaboration is difficult to support.

A natural development for educational virtual world applications is to use a cloud computing architecture to provide a web based interface to data storage, processing and control functions. This can be seen as an evolutionary rather than revolutionary step. The key to the success of cloud based computing is that it provides scalable resources allowing applications to utilise *(and pay for)* only what they need from a much bigger collection of resources where system support and maintenance are provided. This view of cloud computing also applies to some extent to more traditional hosting services where a monthly fee buys a hosting space, web site, database and other tools.

The hope is that interested parties can register with the application to use and contribute to the whole educational resource rather than just the virtual world element. This may provide a more easily sustainable model for communities of practice where the virtual world development expertise can be shared with a wider participating audience.

Outline design for web server recording and control

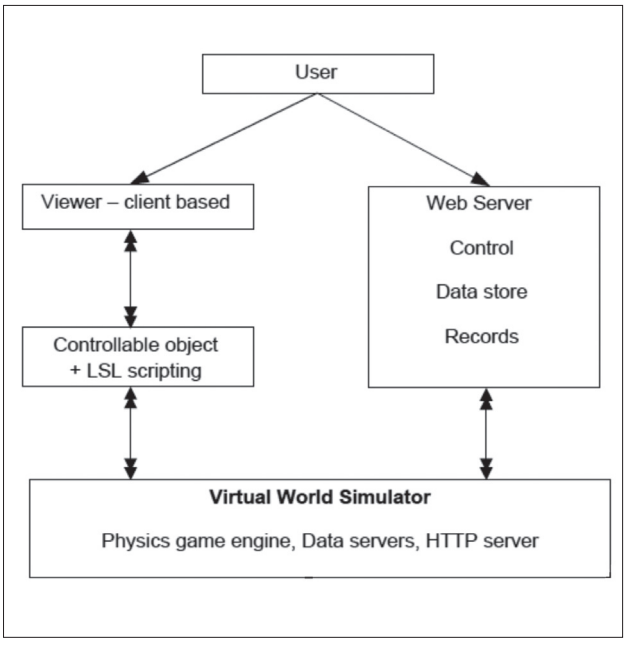
The idea is to use a simple web site with minimal features to capture information from the virtual world simulation and make it accessible to the outside world. An

educational virtual world scenario will consist of a traditional build with landscape, buildings and objects to set the context. Within this context scripted objects will record and communicate information such as location, time, avatar identity and interactions such as how they have been moved and which of the available options might have been selected. The web server will record this information in a database table that is dedicated to that particular scenario. Basic database and text tools will allow the information to be viewed and edited by a tutor and *(if given permissions)* by students. This data forms a record of the interaction for a particular avatar engaged in a particular educational activity. Once the data is in the more generic web server / database environment it can be used either in its raw form or sent on to more educationally oriented systems at the home institution. Figure 1, shows that a user may interact with the virtual world directly through the viewer as an avatar or through a web server that holds information used by scripted objects within the simulation.

Example Applications

In order to convey what this approach is intended to achieve we describe two case studies that are currently being designed and an example that used the Google App Engine with student work.

Figure 1 Outline schematic for user/ system interaction and communication.



Toxic Lab Scenario

A virtual 'Toxic' laboratory is to be set up in Second Life to provide health and safety training for trainee science teachers before they take charge of school laboratories. Interactive objects *(such as chemical containers)* use data stored remotely, accessible via a web interface to determine their location, deployment status and behaviour. Student avatars engage with pre-prepared scenarios and their actions, notes and re-actions are recorded by the system for later reflection.

This project is being assisted with a grant from the Anglia Ruskin Learning and Teaching project fund, for completion in August 2012. As well as addressing the immediate needs of the Education department with regards to training new science teachers, this project aims to disseminate the techniques to a broader range of educational applications. The core technology will be developed to combine in-world activities with information held by an external web server for record keeping and scenario management.

Forensic Crime Scene Scenario

The following case study illustrates how the toxic lab scenario can be expanded to a more complex and flexible application.

Forensic students and practitioners use simulated incident scenes to learn examination procedure and technique. However, a crime scene facility is limited in the number of ways it can be configured and external scenarios suffer from access control and weather conditions. Expense, time and space constraints limit the total number of examinations a student can make and each examination uses consumable resources and staff time to set up and monitor. Students can become familiarised to the scene reducing the impact of the scenario. Group work is an important aspect of forensic examination but in many situations solo work practice is more normal. Given the pressures on the physical resource it is rate for incidents to be run for single users.

A virtual world simulation of a crime scene addresses the following issues:

- Availability – of incident scene to students.
- Variety – of evidence within scenes and range of scenarios.
- Recording – monitoring actions during scene examination and annotating reports.
- Assessment – assessing student performance.
- Reflection – student review of scene examination.
- Feedback – tutor view of student actions and justifications.

It is important to emphasise that the virtual crime scene would be supplementary to the existing resources and would be used to practice and gain confidence in the skills and procedures learned from traditional means.

The potential for collaboration and sharing resources within the wider forensic community in higher education, police, laboratories and public service institutions is restricted by the practical limitations of the ownership and maintenance of a physically located resource. Biomedical, environmental, medical and emergency services also use recreated incident scenes to practice and train but even where there is potential to share resources the costs and practical difficulties typically preclude this.

Data Handling for the Forensic Scenario

The following description provides more details of the functionality of the system and how it would be implemented:

> *Forensic simulation – chosen by tutor or by the student, (from list of simulations) avatar registers with simulation to create data record (data sent to web server)*
>
> *The student will video (machinima) the scene and take photographs (snapshots) of evidence as it is collected, (media files will be downloaded to the student computer, edited and compressed before being uploaded to the web server site)*
>
> *Each piece of evidence will be scripted to react either through touch or a HUD, recording how it was processed (selected as a choice or text input) by whom (avatar key) and when (data sent to the web server).*
>
> *Links to audio and video resources such as simulations of telephone and CCTV will provide more details about the scene (hosted on web server).*
>
> *Students will select the collection procedure, evidence receptacle (from large selection of pre-loaded inventory) and input the recorded details for the sample in the correct format (online evidence form, hosted by web sever).*
>
> *Once completed the student will be able to access the simulation server site to look at and annotate their record from the web site. They can get feedback from the tutor which can be provided as annotations on their record or directly via the home institution email.*

Implementation Details for the Forensic Scenario

During the construction of a scenario moveable objects will have scripts to record positions relative to a central spot in the scenario. The tutor will control the details of a scenario - including the number and location of rooms, floors, interactive evidence and the data associated with them. When the positions are satisfactory these scripts will communicate with the database and record their name, ID and location.

The scenario gets packed away and, when selected by a tutor or student, it can be 'rezzed' *(i.e. created from an in-world inventory)* into an open area with objects consulting the location information of a particular scenario.

For example scenario accident_1 could use all the same components as murder_1 but when rezzed it will leave out the bloody footprints leading away from the scene and have a locked, rather than open, door. Making alterations and recording variations on a scene will be relatively easy by allowing the scene to be modified from the web control *(i.e. selecting objects from an object store)* getting the system to rezz the things that you want then move them to appropriate positions.

Web site control

The core data needed by the system is the scenario name, date, time, region, location, institution, the component objects *(each one with their own ID and location)* and participant*(s)*. Since each scenario instance is unique it allows for multiple scenarios to be configured and deployed. By using a simple data base interface on the web server new scenarios can be created and individually tailored without having to go in-world and without having to know the details of the scripting that supports the simulation.

The web interface is globally accessible so that staff at participating institutions would be able to configure and deploy a scenario, register students with the application, engage with the simulation and access their student interaction records.

Content contribution at a deeper level, such as the creation of new objects and larger scale scenarios would be possible in two ways. Objects can simply be given to the owner of the system who would have to configure them and add them to the database. Alternatively, default template scripts can be given to collaborators to include in their objects to allow automatic positioning and reporting of interactions to the database. Partial or entire simulations could be connected to the system regardless of where they are hosted.

Google App Engine Example

Students exploring application development in second life were given the task of building a fair ground attraction such as a merry-go round, a coconut shy or a shooting gallery. A key part of the task was for the stall to record who had visited and what they scored in order to provide a top ten high score. The Google web pages for the App Engine *(Google 2011)* provide an introduction and examples on how to develop applications for the App Engine as well as details on the *(generous)* limits to free usage. An application was set up on the Google App Engine with basic data management functionality using the Python API but this could have been developed using a Java interface.

Students were given a basic Linden Scripting Language *(LSL)* template *(outline provided in Figure 2)* that would communicate with the cloud based datastore. It uses a listener to respond to typed commands such as *"store"* which collects and transmits data through llHTTPRequest. It also implements http_ response to collect and process the data.

The Google application verifies the HTTP request, stores the data and responds to commands such as creating the top ten list of names and high scores. Figure 3 shows an outline of the code required for the App Engine web server application.

```
// Abbreviated template code for interactive lsl script
default{
    state_entry(){
        //initialise constants and set up listener
        llListen(0,"",llGetOwner(),"");
    }
    listen(integer channel, string name, key id, string message){
        if (llToLower(message) == "store"){
                    //get and set data to be stored and send HTTP reguest
            requestid = llHTTPRequest(" ... add data string...");
        }
    }
    http_response(key id, integer status, list meta, string body){
        if(status == 200){
            if (llList2String(results,0) == "TOP_TEN"){
                // unpack and display top ten score data
} } } }
```

Figure 2 Outline LSL code to send and receive data from Google AppEngine.

```
class MainPage(webapp.RequestHandler):
    def get(self):
        # respond to direct web 'get' request with some text
    def post(self):
        try:
            # validate request is from SecondLife
        except KeyError:
            self.response.out.write("Access from second life only")
        else:
            if self.request.get('action') == "STORE":
                #get data from 'form' process and add to data store
                try:
                    # store data
                    self.response.out.write("SCORE_STORED")
                except CapabilityDisabledError:
                    self.response.out.write("unable to write score")

                        elif self.request.get('action') == "TOP_TEN":
                        # filter data from datastore
                        # sort on score and return top ten results
```

Figure 3 Outline Python Code from Google App Engine to process and store data.

Google supplies administration tools such the dashboard and data viewer *(as shown in Figure 4)* which allow you to inspect and manage the data being stored. Student stalls were left running over a period of months and clocked up around 3,000 rows of data, which consumed about 1% of the available 1Gb free data allocation. The application used even less of the free allocation of processing time *(6.5 hours per day)* and Incoming / Outgoing communications *(1Gb per day)*.

All the data shown in Figure 4, is available to be used by the in-world application. The owner-key is used to allow particular owners to access their data without being able to access or interfere with other information held in the data store.

Students were able to use the resource with no previous knowledge and little need to know about any aspect of the data store.

All they needed to do was to send a valid request to the Google App Engine application, which could insert, amend or delete their data. Validation was based on the owner key which provided sufficient security for this application.

Data protection issues

One advantage of a cloud computing service is also one of its problems. If you don't know where your data is being processed how can you be sure you are not breeching the Data Protection Act *(1998)* or EU directives on data protection *(EU 2004)*? UK institutions using Second Life or Cloud Computing come under the data protection act even if the services they use are not legal entities in the UK.

Recent research at Queen Mary University of London *(Kuan Hon 2011)* addresses the EU perspective on the issue and suggests that if the data is encrypted and secured to recognised standards then it should not be considered personal data. Basic infrastructure services do not in themselves 'know' about the data they are processing and so are not liable. This is good news for data processing but does not address issues relating to more explicit representations of personal data.

The key aspect for Second Life and similar systems that makes it acceptable to UK data protection legislation is consent. At registration with Second Life users are asked to note and abide by the Terms of Service, Privacy and Community Standards *(SecondLife 2010)* and

ID/Name	csv	owner_key	owner_name	player_key
id=74001	New Scores	b0a47255-a528-4fd5-b711-e2703c1f97f3	monkymee02 Deceit	b0a47255-a528-4fd5-b711-e2703c1f97f3
id=74002		717d891b-6ee5-4883-9d56-ba2357a1b84a	Kensei Haramori	717d891b-6ee5-4883-9d56 ba2357a1b84a
id=75003	New Scores	b0a47255-a528-4fd5-b711-e2703c1f97f3	monkymee02 Deceit	b0a47255-a528-4fd5-b711-e2703c1f97f3

player_name	region_name	score	stall_name	timestamp
monkymee02 Deceit	Anglia Ruskin University	20	Andrew's Cannon Stall	2010-12-01 23:51:35
Kensei Haramori	Anglia Ruskin University	0	Kensei Haramori's Crazy Bowling Adventure	2010-12-02 11:27:36

Figure 4

Data storage with student avatar application data.

this provides the consent for data handling. If a particular user decides to publish some personal data through their avatar then that does not come under the data protection act.

These issues were recently *(April 2011)* considered by the Faculty of Science and Technology Ethics Committee at Anglia Ruskin University when we were asking for ethical approval to use student participants to evaluate virtual simulations in Second Life. Here are some relevant extracts from the approved proposal:

To access the virtual world a user will have to have an avatar which requires registration with Second Life. The registration is authenticated against a real world email account, which is the only personal information that is required and held under the Second Life privacy agreement *(2010)* as part of the terms of service contract. However, this data is held under US law and does allow access by third parties under certain exceptional conditions. Participants of the system will be informed of this and directed to the Second Life terms of service agreement in the participant information sheet.

The Google App Engine will be used to host an application that will control the selection and deployment of virtual crime scenes and record user interactions. The data collected from a session will be linked to the avatar name from which it is not normally possible to derive any personal details from the real world account holder. In their privacy policy as well as general statements of security and



Figure 5

Austin at the Shooting Range showing scores served from the App Engine..

[2]Details of the data protection act and guidance are available at: http://www.ico.gov.uk/for_organisations/data_protection/the_guide.aspx

privacy Google state that they adhere to the US safe harbours agreement *(Google 2010)*. To conform to best practice explicit permission for data held on cloud resources will be part of the participation consent.

Consent that is required though a contractual obligation is not prohibited by the data protection act so that it would be possible to tell students that they have to give consent if they want to do the module. However, best practice would be to get signed consent from students at the point of registration on a module or, if the module is compulsory for their degree, when they first register with the University or College.

The extensive use of Second Life in the UK Higher Education sector helps support the conclusion that individual student registration with Second Life provides a way of gaining consent and sufficiently anonymising personal student data. For this reason we recommend that the avatar name is used for all cloud based services such as record keeping and any other online educational activities. It would then be up to the tutors using such a system to keep records that linked avatars to individuals within the remit of the data protection policy of their institution.

Conclusion

This paper has looked at a model of technological uptake to put the current status and future development of virtual world educational applications into context. It suggests that greater use of tools that allow sophisticated interaction customisation and deployment could help increase the uptake of virtual world educational applications. It identifies the model provided by Cloud Computing as a useful approach for deploying both virtual worlds and educational applications.

The description of the Google App Engine example used by students to record and display information shows that it is relatively easy to provide services where the intricate coding details are hidden from the users. The Toxic Laboratory project seeks to extend this principle to a more sophisticated communications and storage infrastructure. The aim is to allow interactive scripted objects to record information and take instructions from an external data and web server. The benefit of this approach is that by separating the implementation details of the virtual world from the more generic storage and processing of data we can facilitate greater user interaction with less specialised technical knowledge. The forensic crime scene case study was used develop these ideas to illustrate the functionality of a system based on this approach. The interesting side effect of this is that once the web based control and recording interface has been developed for use by one institution it is trivial to allow other collaborators to utilise the same system.

The next step is to complete the development of the Toxic Laboratory and to encourage collaborators to use the resource in their own teaching practice.

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Learning the language of design in SecondLife

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Keywords: Second Life, design, education, language, collaboration, skills development.

Abstract

This paper discusses a pilot research study carried out for an European Funded project: Architectural and Design based Education and Practice through Content & Language Integrated Learning using Immersive Virtual Environments for 21st Century Skills (ARCHI21). Open University Design students participated in learning sessions, the focus of which was the acquisition of design specific language skills and the development of skills for the generation and interpretation of design briefs. Sessions were held in SecondLife and one session used a conferencing tool (FlashMeeting). Students had a mix of linguistic backgrounds and design expertise.

The study highlights a number of practical issues around organisation and technical support for successful in-world teaching. Importantly it shows how in-world teaching can support an atelier style of learning in which participants learn through practical, knowledge based and cognitive activity.

Introduction

This paper discusses a research study carried out for the European Funded Lifelong Learning programme project: Architectural and Design based Education and Practice through Content & Language Integrated Learning using Immersive Virtual Environments for 21st Century Skills *(ARCHI21)*.

The study was a pilot for future work to be undertaken with partner institutions across Europe. An open invitation to students taking modules in the Design and Innovation BSc award sought participation in a series of sessions on the subject of design briefs. This subject is critical to an understanding of designing and the design process. From the researchers' point of view the focus of the study was the acquisition of design specific language and development of skills required for the generation and interpretation of design briefs. Seventeen students with a mix of linguistic and professional backgrounds volunteered to take part, half of whom were 'English as an additional language' *(EAL)* speakers). None of the student participants had had previous experience of SecondLife.

The students recruited took part in five sessions conducted in SecondLife and a sixth session, conducted using an audio/video conferencing tool *(FlashMeeting)*. Work in each session was planned and facilitated by four Design lecturers. The lecturers comprised one native English speaker and three fluent EAL speakers. An English language specialist attended all sessions acting as observer and feeding back observations on the use of language at the end of each session. In addition technical support was provided by a SecondLife expert who was present in all sessions.

The effectiveness of the teaching sessions was gauged using participant observation by the researcher-teachers and review of recorded sessions as well as in-world discussions with the students about the progress they made.

Design of the learning sessions

The primary aim of the in-world sessions was to aid all participants in the acquisition, development and appropriate use of the language of design. The focus was on the design brief and early concept proposals. The sessions, summarised in Table 1 below, were designed from a linguistic viewpoint, to gradually build up knowledge and understanding of common design terms used in design briefs and specifications.

Session	Content	Intention	Medium
1	**Introduction** Introductory meeting including tuition and practice in basic SL building skills Language: Social language	Orientation in-world, resolution of technical issues	SecondLife
2	**Retro-writing a design brief** Students engage in a discussion with the aim of writing a design brief for an egg, considering aspects of fragility and how these influence the design brief. The focus is on informal language and ability to use technical terms to describe objects. Language: Language history, Exploratory Cumulative, Possibility	Ability to understand and communicate properties of artefacts and the requirements behind their creation; understanding and using informal and formal design terms.	SecondLife
3	**Collaborative building of an object based on a given design brief** Students work in groups to build an object chair for the fictional character 'Humpty Dumpty' in response to a given brief. Consideration of fragility from a technical, as well as social and environmental perspective is encouraged. The focus is on the ability to communicate effectively within the group. Language: Negotiation, Suggestion, Agenda and Time Management, Social, Collaboration and Consensus Finding	Development of ability to build collaboratively and engage in conversation about operational aspects as well as understanding the technical terms given in a design brief.	SecondLife
4	**Creating a new design brief** Students work in groups of two or three in an audio/video conferencing interface. Each group defines a context for a design brief embracing the notion of fragility (e.g. in terms of environment, aesthetics, function/performance, experience) and creates a brief within given guidelines. Students are encouraged to draw objects as a way of exemplifying and communicating the brief. Language: Unpacking the use of terms, written language, academic language	Creation of a new design brief in a collaborative setting requiring the ability to communicate abstract goals and ideas on the fly.	Flash Meeting
5	**Interpreting a design brief** Groups swap briefs created in Session 4. Each group is developing objects to satisfy the given brief. Group interaction involves language interpretation and communication as well as object creation. Language: Evaluation, Communication, Negotiation of meaning, Building and making	Developing a deep understanding of the creation of a design brief and the interpretation of ideas and terms at different levels of detail.	SecondLife
6	**Presenting a design proposal** Each student gives a short verbal presentation of their interpretation of the given design brief and the resultant design. Language: Presentation, Comparison, Developing	Formal presentation of a design project as an important part of design learning and practice.	SecondLife
	Arguments		

Table 1 A brief overview of the content and intention of the learning sessions.



Figure 1 Building in SecondLife.

Technical issues

The introductory session established that 6 of the 17 participants had some difficulties with the interface, in particular with hearing or speaking. Attempts to address this in-world met with partial success. However, resolution was complicated by attempts to use text chat where, simultaneously, messages from other participants about the content of the session were being posted. Ultimately the conversations were moved to Skype where detailed advice could be given about installing a different viewer or changing settings to enable voice. Use of Skype also enabled those assisting to establish that the student had a viable microphone/speaker set up. The researchers themselves found that SL viewer 2 rendered poorly on a networked computer and used Imprudence to overcome this difficulty. A number of students encountered problems with SL2 and were advised to switch to Imprudence. However, some issues were resolved by logging out, re-entering SL2 and choosing 'advanced preferences'. Establishing which viewer students were using and giving advice appropriate to that interface was critical in sorting out problems with less confident students. One student who experienced technical problems did not continue with the sessions.

In later sessions, technical problems were experienced, intermittently, by individuals. These appeared to be network related, for example dropping out of world or losing sound for a short period. However, this did not significantly impact on those students' overall participation and fellow participants were supportive and understanding of the issues whenever this occurred.

The resolution of most of the student technical issues was achieved without specialist technical intervention, however, set up of the on-line environment and support around the building activities required a dedicated technical expert *(His Dudeness)* to work in conjunction with the research team. The technical expert was also responsible for building the learning environment, which needed to be appropriate to the pedagogy, learning tasks and methods of working. This learning environment was crucial to the study as it enabled participants to feel safe in a private and protected online space.



Figure 2 Participants gathered in a plenary session to create a design brief for an egg.

Findings and lessons learnt

Schwienhorst *(Schwienhorst 2002)* discusses the higher cognitive engagement that can be achieved in a virtual environment stating that a virtual environment centres on the learner and enables the learner to exercise greater control than in a face to face situation leading to greater interaction with other participants. Furthermore, this interaction is facilitated by the participants' construction of an identity, through the appearance and naming of their avatar. This identity construction gives each student an online 'presence' which may have very different social meaning from their physical world selves *(Biocca 1997)*. This creation of identity is seen in names such as *"KnittingClaire"(English woman)*, *"freddyfrog" (Frenchwoman)*, *"aforestsomewhere" (English woman)*, *"Vorx" (English man)*, *"YorkyMike2" (English Man)*, *"MariatheHun" (Hungarian woman)*, *"nketiah" (Ghanaian man)*. In the same way choice of dress, avatar shape and physical features communicated messages about the participant that overtly expressed how they wished to be perceived by others *(Figure 2)*.

The researchers observed that this creation of online identity combined with the ability to communicate multi-modally, by voice, text or gesture facilitated high levels of participation from all participants within a short time frame. It was observed that in the early sessions native English speakers often took a lead in the learning activities, however as confidence grew, contributions from native and non-native speakers were indistinguishable and were related more to confidence with ideas than confidence with language.

Participants perceived great value in the affordances of the virtual world. Two affordances in particular were identified, first the ability to meet with fellow remotely located students in a non-threatening environment where informal communication could take place and second the ability to give form to creative ideas using the building tools. These tools were seen as a possible alternative to the 3D drawing software provided on the Design courses. Participants were keen to be able to return to the space for meeting after the study was concluded.

For the facilitators the virtual world offered the opportunity to devise experiences that would not be possible in a face-to-face or 2D online environment allowing elements of surprise and delight to be bought into the teaching environment.

In contrast to the virtual world, the conferencing session had mixed success and became more facilitator dependent. It was noted that in the conferencing activity some participants were comfortable with using webcams to show their true identities but a greater number chose to have voice only interaction. The different levels of engagement could be attributable to the nature of the task or to the disjuncture between the in-world environment and the less familiar conferencing environment. However, this difference demonstrated that once inducted in the virtual world, students were comfortable with the level of interaction that it afforded them. The caveat being that the students were self-selecting and motivated to try this environment.

As Deutschmann et al found *(Deutschmann, Panichi et al. 2009)*, students who experienced technical issues were unable to immerse themselves in the environment fully. However, unlike the Deutschmann study, we found that once technical problems were sorted out students quickly became familiar with the affordances of the interface. This could be related to the nature of the subject studied *(design students need to learn early on to deal with uncertain situations and to use available technology creatively)* and the students who volunteered but it may indicate a general reduction of fear of technology.

There was no discernible difference in the spoken contributions of native and non-native English speakers once familiarity with the interface and technical issues were resolved. However, it was observed that the students who experienced the greatest technical issues were predominantly non-native English speakers, which may indicate some unintended cultural or linguistic bias in the preparatory instructions or in the interface itself.

SecondLife offers an environment in which participants learn through doing, with 'doing' in this study being practical *(i.e.the use of SL tools)*, knowledge based *(knowledge and understanding of design process)* and cognitive *(the ability to communicate and think in a designerly way) (Cross 2006)*. This facility to learn by doing shows clearly the potential of in-world experiences to support an atelier style of learning in which both design skills and language acquisition can take place in tandem *(Seeley Brown J. 2007)*. However, the resources and time required to develop a conducive in-world environment, aid novice users with their use of the interface and prepare teaching resources was significant.

In the final session a student reflected that: *"I think that in general SecondLife provides an excellent environment for teamwork, group work, any sort of collective work. The audio side of course is very easy. Press a button and speak. There were some issues perhaps with network bandwidth from time to time, … audio discussion is very easy, typing also. We are very used to speaking English and typing, so that isn't an issue. The greatest difficulty was in creating and editing and merging objects."*

We have learned that SecondLife requires additional training and support in creating and editing objects, both individually and collectively, as part of the induction into learning for the discipline of design. The need to develop students' ability to work collectively is surprising because in real-world design education, students usually would not dare to modify someone else's designs. There might be discussions around possible modifications, but the actual modification is carried out by the owner of the object. In-world it seems that the idea of editing and modifying someone else's design is inviting and even desirable though not very easy to manage technically.

Conclusion

The research reported here will continue in collaboration with international partners in two further pieces of in-world teaching in the next year. It is hoped that, having learnt from this experience, the implementation and teaching for the subsequent studies will be easier. In parallel to the work carried out for this study partner institutions in France conducted Architecture based teaching sessions in-world with students who ordinarily attend face to face teaching sessions. The reports of this work suggest that even in a conventional higher education setting the affordances of the in-world interface, for example the ability to visit and critique virtual buildings and to visit architectural teaching resource sites, offer students the potential for key skills development that extends and enhances their understanding of the subject.

Further research on the use of virtual worlds in design education to continue exploration and development of appropriate pedagogies for online design atelier teaching could make a significant contribution to distance learning in a multi-national setting.

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+SPACES: Serious Games for Role-Playing Government Policies

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Abstract

The paper explores how role-play simulations can be used to support policy discussion and refinement in virtual worlds. Although the work described is set primarily within the context of policy formulation for government, the lessons learnt are applicable to online learning and collaboration within virtual environments. The paper describes how the +Spaces project is using both 2D and 3D virtual spaces to engage with citizens to explore issues relevant to new government policies. It also focuses on the most challenging part of the project, which is to provide environments that can simulate some of the complexities of real life. Some examples of different approaches to simulation in virtual spaces are provided and the issues associated with them are further examined.

We conclude that the use of role-play simulations seem to offer the most benefits in terms of providing a generalizable framework for citizens to engage with real issues arising from future policy decisions. Role-plays have also been shown to be a useful tool for engaging learners in the complexities of real-world issues, often generating insights which would not be possible using more conventional techniques.

Introduction

The EU +Spaces project *(Positive Spaces—Policy Simulation in Virtual Spaces)* explores how virtual world technologies can enable government agencies to measure public opinion on a large scale and maximize the value from prospective policy measures by leveraging the power of virtual world communities *(Tserpes et al, 2010)*. The project aims to build applications that range from simple polling and debating to more advanced role-play simulations of government policies. Many of the challenges for the +Spaces project are shared with immersive education and there are close similarities with the use of virtual worlds for educational 'Serious Games' that are designed for the purpose of solving a problem. The project will be using some of the ideas from serious games to provide a framework for engaging with citizens in role-playing activities, allowing them to explore the implications of proposed government policies.

In the context of +Spaces, the scope of 'Virtual Worlds' is broad. 3D immersive virtual environments typically allow users to collaborate with one another in an online virtual space. However, the project also considers simpler environments that allow users to meet and share information within a social network to also constitute a type of virtual world. Users of social network environments, bloggers and microbloggers all communicate with each other within their respective systems, creating rich patterns of interaction. Examining these systems will enable us to tap into an extensive and diverse user base, overcome some of the entry barriers to the 3D environments, and study a wider variety of technologies to receive more representative insights into the problem domain.

The project exploits the viral dissemination properties of social networking services to build up engagement with large groups of citizens online. Also, one of the additional significant challenges of the project is to provide generalised middleware which can deploy and manage +Spaces applications *(polls, debates and role-play simulations)* across these different virtual spaces simultaneously *(Kardara et al, 2011)*.

This paper begins by examining both 3D immersive collaborative spaces and 2D social networking services. These are the main categories within which the +Spaces applications will be implemented. For each category we make a clear definition of each

area, in terms of how they will be used by the +Spaces project. We then examine some of the issues related to the creation of role-play simulations to support policy-making scenarios—ultimately the most challenging part of the +Spaces project. A number of different simulation scenarios are identified, and the issues and challenges for the project are clearly highlighted.

3D Virtual Worlds

The term 'Virtual World' is often poorly defined. For example, Wikipedia describes it as *"an online community that often takes the form of a computer-based simulated environment, through which users can interact with one another and use and create objects" ("Virtual World,"* 2011). More specifically in this section we are considering three-dimensional *(3D)* virtual worlds, as a specific sub-group within this wider virtual world definition. These are interactive 3D virtual environments, where a user takes the form of an avatar visible to others graphically, usually depicted as two-dimensional or three-dimensional graphical representation. Other key characteristics of a virtual world are that it is a multi-user environment that supports synchronous communications between its users, and the state of the world persists beyond a user's session.

3D virtual worlds have been used for a very wide range of applications, which can often make it difficult to generalise about their characteristics and the benefits that accrue from the use of the technology. Figure 1 illustrates one possible framework to describe the use of virtual worlds, derived from the observation of virtual worlds for teaching and learning. Here one dimension is the formality of usage, i.e. if the world is a controlled environment for formalised operation *(such as online lectures)* or is an informal space for users to enter when needed *(such as a museum environment)*. The other dimension indicates if the world is primarily built to allow its users to interact with the three-dimensional content *(such as a science experiment)*, or if it provides a set of tools to allow its users to collaborate more effectively with one another *(such as a collaborative working environment)*. The intended use of the virtual world will also determine how its effectiveness may be evaluated. For example, the evaluation of a world designed to support e-learning would need to consider the pedagogical issues whereas a world designed for business collaboration would have more pragmatic success criteria *(such as ease of use for setting up meetings)*. However, whatever the requirement, the decision to employ a virtual world will usually be based on two fundamental objectives, that of cost *(it is cheaper to achieve in a virtual world than in real life)* and safety *(it would be too dangerous or impossible in real life)*.

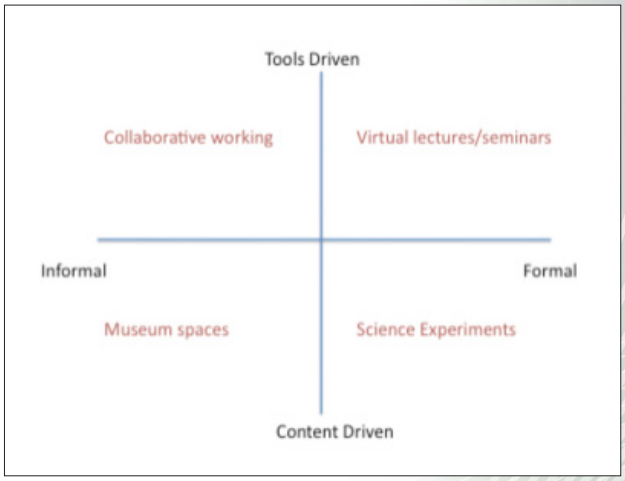


Figure 1 3D Virtual Worlds Usage Framework

There are also several key technical and service characteristics which can help to differentiate between different types of 3D virtual world platforms. These are:

- Business model: proprietary/commercial or open source
- Hosting: public subscription model, private hosted or deploy on own server
- 3D content creation: proprietary or open art path, in-world or external tools
- Robustness: suitability for mission-critical deployment
- Client: downloadable install, Java applet, browser-based
- Extensibility: scripting, APIs, extensible module architecture, development environment
- Graphics engine: OpenGL, DirectX, Flash, jMonkeyEngine
- Notable features: voice communication, shared applications, streamed media, etc.

- Scalability and performance: number of concurrent users, extensible architecture, behaviour on server or client
- Graphics quality/fidelity
- Client hardware requirements
- Collaboration tools e.g. shared applications, voice communications, chat, etc.
- Online social dimensions, e.g. whether the world has an economic model
- Types of users supported
- Privacy/security, authentication

Given the current state of development of 3D virtual world technologies, the key technical differentiator of robustness seems to be dependant on the business model adopted by the technology provider. Commercial suppliers such as Linden Labs and Unity Technologies have invested many millions of dollars in the development of their respective platforms for specific niche markets, and are generally regarded as being fairly resilient well-supported platforms. Alternatively, there are several free open-source offerings such as OpenSim, OpenWonderland and Open Cobalt™, all at relatively early stages of development, and with variable levels of training and support. Consequently these latter platforms have so far been more widely used in research rather than for mission-critical applications.

2D Social Networking Services

A 'social networking service' has been described as *"online service, platform, or site that focuses on building and reflecting of social networks or social relations among people, who, for example, share interests and/or activities" ("Social networking service,"* 2011). Thus, the key components of social network services are the data encompassing the connections between people who are members of the service. However, all the social networking services contain additional components, which, combined with the social network structure, enable users to communicate with their networks.

Social networking sites tend to share some conventional features. Most frequently, individual users are encouraged to create profiles containing various information about themselves. Users can often upload pictures of themselves to their profiles, post blog entries for others to read, search for other users with similar interests, and compile and share lists of contacts. In addition, user profiles often have a section dedicated to comments from friends and other users. To protect user privacy, social networks usually have controls that allow users to choose who can view their profile, contact them, add them to their list of contacts, and so on. In recent years, it has also become common for a wide variety of organizations to create profiles to advertise products and services.

Social network environments are uniquely positioned for viral dissemination of information. When a user posts a status message, comment or link, their friends/contacts are immediately informed. If they find the information interesting, they can easily propagate the information to the circle of their friends, and so on. Information received via a friend is given preferential treatment by its receivers, thus enhancing its effect even further.

Social networking services have a huge market share. Nielsen Reports finds that even in 2009 *"social networks and blogs are now the fourth most popular online activity ahead of personal email. Member communities are visited by 67% of the global online population, time spent is growing at three times the overall Internet rate, accounting for almost 10% of all Internet time" ("Social Networks,"* 2009). Tapping into this immense user base seems worth exploring in the context of the +Spaces project.

Many different social network services are available, however they are often categorized into three broad types: social networks environments, blogging environments, and microblogging environments. These groups share many features, and overlap to a certain extent, but are sufficiently different that we would like to explore the use of a representative member of each type. In this section we give a general description of each type.

Social Networks Environments

Social networks environments such as Facebook, LinkedIn, Orkut® and many others, focus on *"friending"* networks. Users explicitly create connections with other users within the service, and thereafter interact closely with their friends. Users can update their friends on their activities, interests and recommendations, and this information in turn can become the basis of comments and feedback.

While the basic structure is that of a graph, many social networks environments also provide the concept of groups, created by users to assemble people who share common interests. Members of a group can view content specific to the group, and communicate with each other within a common space.

Social network environments already offer abilities relevant to the +Spaces agenda. User-posted content often sparks hot debate among the user's friends, which is then propagated to friends of friends. Polling mechanisms are implemented in various ways in many environments, either through third-party applications or as an integral part of the system. Different design decisions on the part of system implementers have resulted in the creation of several privacy models. Users can control the access of others to information they create, and groups restrict certain actions to members of the groups. Some information is open to the general public. This offers interesting issues to explore: to what extent do people radicalize or tone down their rhetoric as a function of how widely they expect it to be disseminated? Can polls be propagated notwithstanding privacy controls? Do peer pressure effects apply in virtual social groups? To what extent do language barriers inhibit the propagation of information within social networks? These questions and others are key to the study of social network environments in our context.

Blogs

Blogs *(or web logs)* are *"usually maintained by an individual with regular entries of commentary, descriptions of events, or other material such as graphics or video" ("*Blog," 2011). Blog posts tend to be *"heavy"* in content, with descriptions of new information discovered, compendia of references to useful materials, opinions and analysis. Users can encounter blog posts while searching the Internet for relevant keywords, or can subscribe to read content in a specific blog. Some blogs have restricted access, but most are open to the public.

A key feature is the ability of other users to comment on blog entries, potentially creating conversations centred on topics of interest to the community. Blogs and blog posts are often tagged with metadata terms, thus creating a rudimentary searchable categorisation of topics, useful to users who are looking for blogs relevant to their interests.

Blogs are uniquely suited to act as focal points for debates. While social networking environments focus on short, informational content, blog posts often contain extensive, well-researched and -referenced opinion pieces, which spark off debate among commentators. Furthermore, an influential blog post will often prompt other bloggers to respond in their own blogs, thereafter propagating the discussion.

Microblogging

Microblogging environments are similar to blogging environments in that they enable users to post individual content. However, as their name implies, the content is severely restricted in size, thereby creating a very different set of interactions between users. Whereas blog posts are often long, well thought out opinion pieces, microblog posts are short, often fragmentary messages. As such, they lend themselves easily to other modes of interaction.

Users of microblogging environments subscribe to follow posts by others in whom they are interested, and environments usually offer some level of access control to restrict followers. Microblogging environments are often used for the broadcasting of pointers to content on different sites, for the benefit of the users who are following another user's stream of posts. Some sites also provide metadata tagging possibilities, to help users categorize and search for interesting people or topics to follow. Microblogging is thus a key component in the viral dissemination of information.

Microblogging environments are ideally suited for use as polling platforms. Poll questions can be floated into the environment as posts, and answers or responses are posted by other users thus spreading information about poll participation and prompting more users to contribute their views.

Simulation in Virtual Spaces

The +Spaces project is based on the underlying concept of a Virtual Space as a micro-society: it has the many of the same dynamics as the real world, based on the virtual interaction between real people. Furthermore, existing Virtual Spaces incorporate the dynamics of social networks that are already widely established, making them an ideal testbed for experimentation of a simulation of policy.

It is envisaged that the reactions governments would see in a Virtual Space would be participants' real responses to simulated situations, rather than simulated responses in hypothetical situations. It is believed that these measured reactions could be extrapolated to derive conclusions for the society at large.

+Spaces does not propose to create a simulation of society, something that is extremely difficult *(if not impossible)*. Instead it intends to use environments that are already simulations of reality, miniatures of society, which are richer in characteristics of reality. The intention is for +Spaces to provide the tools to translate the behaviour in these spaces to predicted behaviour in real spaces. Virtual Spaces are seen as ideal environments because the +Spaces applications of polling, debating and simulation could be applied seamlessly across several Virtual Spaces.

This vision of using Virtual Spaces for simulating government policy presents several challenges. This section of the paper provides some more concrete examples of the use of Virtual Spaces for simulation and some proposed implementation scenarios. It begins by highlighting some of the issues involved.

Virtual Space Simulation Issues

Policy simulations present several challenges when it comes to modelling the real world. For example how easily can we change a person's regular habits? How can we interpret a habit based on the simulation of a policy?

We also need to be clear about what policy simulations can achieve that polls and debates cannot. The policy maker uses a poll to ask a specific question whereas the topic of a debate is usually more open but rooted in a core issue. However, when considering the simulation of a policy, the policy maker may not know the question to ask. Users give direct answers to polls and in debates they give more open answers. When participating in a policy simulation user may be unaware that they are answering any question at all.

Simulations may also exhibit a Hawthorne effect—if we force users to behave in a certain way, they will typically start to adapt their behaviour—that means that people that participate in simulations are likely to change their opinions about the topic being studied.

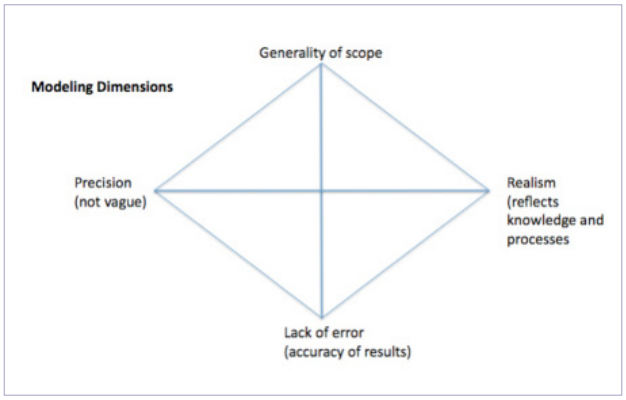
A key issue for +Spaces is the lack of reusable simulation models. Most existing simulations, such as the BBC Climate Change Simulation combine an underlying simulation model *(the rules and conditions which affect climate change)* with a virtual environment or user interface, which enables users to explore and engage with the simulation. Furthermore, many existing simulations are highly complex game-playing environments, which contain rich graphics, story narratives and game-playing metaphors.

There is also the issue of how to encourage citizens to engage in policy simulations. People generally want to engage with a simulation because they are interested in the topic *(such as climate change)*, or they are enticed by the game-playing or entertainment provided by the simulation *(such as Farmville)*. A policy simulation, then, has to attract users to participate—this challenges policy makers to design a simulation that entices a wide variety of users.

A simulation model is generally measured by four factors *(Edmonds and Hales, 2003)*:

- Generality of scope *(i.e. broad scope)*
- Precision *(i.e. not vague)*
- Realism *(i.e. reflects knowledge and processes)*
- Lack of error *(i.e. accuracy of results)*

A simulation model should aim to combine all of these factors, as illustrated in Figure 2. However in reality it is very difficult to combine all four factors in a single simulation, and policy simulation rarely goes beyond two factors. Generally 'lack of error' and 'generality of scope' is seen as the key dimension for policy simulation.



Virtual Space Simulation Scenarios

The following scenarios for +Spaces virtual space simulations were identified as possible areas for future exploration at a project workshop:

- Recycling: engaging users in a game that would examine their willingness to recycle. This could involve users exploring the following issues: what is rubbish? Where does it come from? Where does it go? A simulation could involve users having their own virtual homes and activities that produce rubbish of different types, such as organic, plastic, paper, glass, metal.
- Transportation simulations: modelling the transportation infrastructure for a particular area such as a town or city. This could be combined with some form of traffic modelling to dynamically vary the characteristics of the simulation *(such as congestion, speed of traffic)*, and allow users to explore some of the implications of transport policy implementation *(for example, closing some streets in central Athens for pedestrians only)*.
- Marketplace simulations: some Virtual Worlds *(such as Second Life and Farmville)* implement their own internal monetary systems and currencies that can be used to buy virtual goods and services. Users can purchase internal credits with their real currency, and it has been proved by past research [25] that there is a close correlation between real and virtual buying behaviour. Virtual Worlds could therefore provide an ideal simulation for economical policies based on a defined marketplace for virtual goods and services.
- Learning simulations: the SIMiLLE project investigated the technical feasibility and pedagogical value of using virtual worlds to provide a realistic socio-cultural setting and content for second/foreign language learning. The role of the virtual world was to provide a rich environment for learners to practice their language skills in a variety of realistic settings *(Gardner et al, 2011)*.

The above simulation scenarios all require the implementation of some form of specialised game-like environment that mimics a real-world setting. This can be difficult to achieve, as it demands the accurate representation of a real-world setting within an artificial environment. Such an environment can be both challenging to model graphically and also complex to model in terms of the behaviours, such as transportation congestion, marketplace currencies. It may also be problematic to attract users to participate in these new environments.

Role-Playing in Virtual Worlds

A common problem with computer-based simulations is the 'black-box' nature of their underlying internal models, whereby they are hidden from the end-user. This may be of benefit in terms of improving the overall usability of the interface, but is a major weakness for a policy-making application, where the rules of the internal model will make up the framework for the implementation of any new policy. From a policy-making perspective the transparency of the internal model is critical to understanding the factors that will affect the successful or unsuccessful

[1] http://www.bbc.co.uk/sn/hottopics/climatechange/climate_challenge/

outcome of any new policy. Also, by the nature of their implementation computer-based simulations are often very specific to a particular problem domain and do not generalise well, if at all. Consequently, it becomes difficult for the +Spaces project to develop a general framework for policy simulation in which each policy does not require its own particular implementation. This observation makes computer simulations an infeasible option for the project, as it does not support the dissemination and use of the outputs from the project by other parties.

Other experts support this observation. For example, Prof. Richard Duke is a pioneer of computer based urban simulation games and is President of the International Simulation and Gaming Association. His work has moved away from using simulations because of their black-box nature. Instead, he has adopted a more general approach based on role-playing simulation exercises that allow different players to engage with each other. Duke believes that this approach provides a far less deterministic outcome, which is more generalisable, and introduces the benefit of an unpredictable element of human choice into the process *(Duke & Geurts, 2004)*.

Thus, our preferred simulation scenario is to provide Virtual Spaces in which participants themselves can act out a particular government policy issue through an online role-play activity. This scenario could be a mediated task, facilitated by an



Figure 3. Role-Playing Simulation Scenario.

online moderator, whereby participants are assigned roles *(such as central government policy maker, civil servant, local government agent, citizen)* and then asked to act out a particular simulation role-play *(such as the implementation of a new waste removal service by private contractors)*.
The role-play could take place in virtual worlds that visually recreate the location of the intended policy, such as town hall, local street, or city centre.

This type of virtual world simulation is often referred to as a 'serious game'. Serious games are often used where it would be too dangerous or too costly to attempt the learning exercise in a real-world setting. Examples include safety training on oil rigs and war-gaming exercises. In both these examples, the keys factors are:

- A realistic virtual world environment *(reflecting the real world)*
- Multi-player scenarios and collaboration, often with users role-playing different characters *(such as paramedic, doctor, patient)*
- A rich underlying model reflecting the real-world behaviours available *(such as fire fighting capabilities on an oil rig)*

The creation of a serious game learning exercise presents similar issues to those identified for simulations such as the problems of generalising across multiple domains and multiple deployment platforms. However, research in the field of serious games has resulted in potential solutions to these problems. One such solution is PIVOTE: an open source virtual learning authoring system for virtual worlds *(Burden & Jinman, 2011)*. PIVOTE provides authors of serious game learning exercises with a form-based user interface to create a decision tree of game steps. The learning exercises generated by PIVOTE can be seen as isomorphic with the role-playing exercises necessary for +Spaces policy simulation. PIVOTE could be used as the means to enable policy makers to specify the role play of a simulation. The additional benefit that we can exploit from PIVOTE is its ability to simultaneously deploy exercises onto several platforms *(including Second Life, OpenSim and web)*, and that it uses an open architecture based on web services.

Within the context of +Spaces, users could be exposed to a simulation activity of this kind, which is then followed by an online poll and debate *(using the other +Spaces applications)* that can help to capture further quantitative and qualitative information about the user's perception of the main issues arising from the simulation. Such a sequence is illustrated in Figure 3.

It is important to remember that the key end user role of the +Spaces applications is that of policy maker: a person from a government agency who typically has no expertise either in the creation of virtual spaces or serious games. Thus, it is critical that we provide this user with guidance on how to create role play simulations. With this in mind, the project has been exploring the use of role-play templates to help policy makers devise an appropriate role-play simulation to support a given policy issue. The following are examples of existing role-play templates :

- Galactic wormhole: participants imagine themselves to be five years in the future and reflect on positive and negative outcomes of a particular strategy
- Depolarizer: structured game based on the philosophy that many issues that we treat as problems to be solved are actually polarities to be managed
- Environmental decision-making: participants learn about a particular environmental issue from multiple perspectives by interacting both online and face-to-face with their peers about a topic in assigned "stakeholder" roles

[2]http://www.learningdesigns.uow.edu.au/guides/info/g1/index.htm

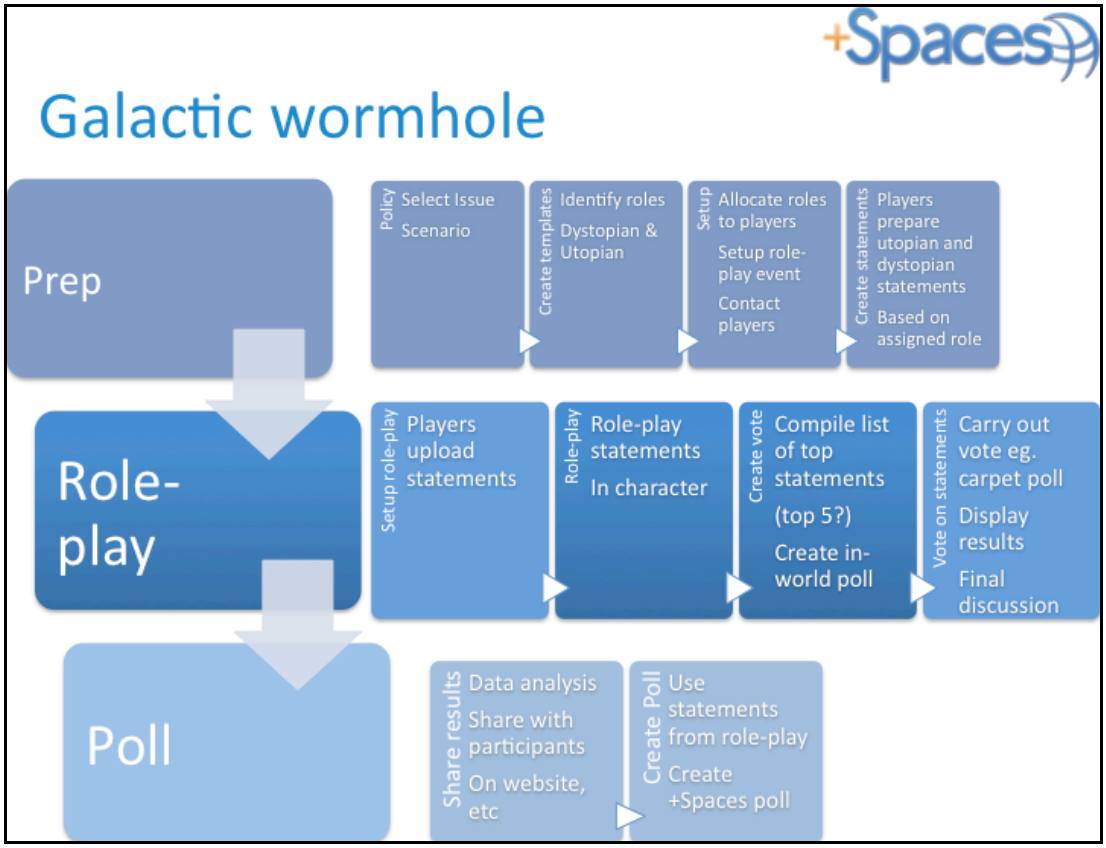


Figure 4

Galactic Wormhole Role-Play.

Figures 4 and 5 illustrate the stages of the Galactic Wormhole and Depolarizer role-plays, respectively. We have successfully used these templates within the project as part of a *"real world"* workshop and plan to implement them in a forthcoming stage of the project.

Figure 6 illustrates a screenshot from an early prototype based on Open Wonderland of the second stage of the Galactic wormhole template. The participants have uploaded their statements and other supporting documents to the virtual world, arranged around the periphery of the space. On the floor of the space is a *"debating carpet"* on which users can register their degree of agreement with questions posed by a moderator.

Role-playing is an approach that has been effectively used for many different purposes such as predicting outcomes, war-gaming, team-building and training. Aspects of role-play have already been used elsewhere in online theatre, gaming, focused discussion forums, and so on. The innovation for the +Spaces project is in the application of role-playing as a simulation tool for policy makers. The consequent challenges for the project include:

- How to support online citizen participants across different virtual space platforms
- How to provide policy makers with a user interface in which they are able to define a role-play and then select users and schedule *(and setup)* a role-playing simulation event
- Managing the structured role-play in a virtual space according to the steps defined in a template
- Capturing the results from the role-play simulation
- Analysing the results to support policy making

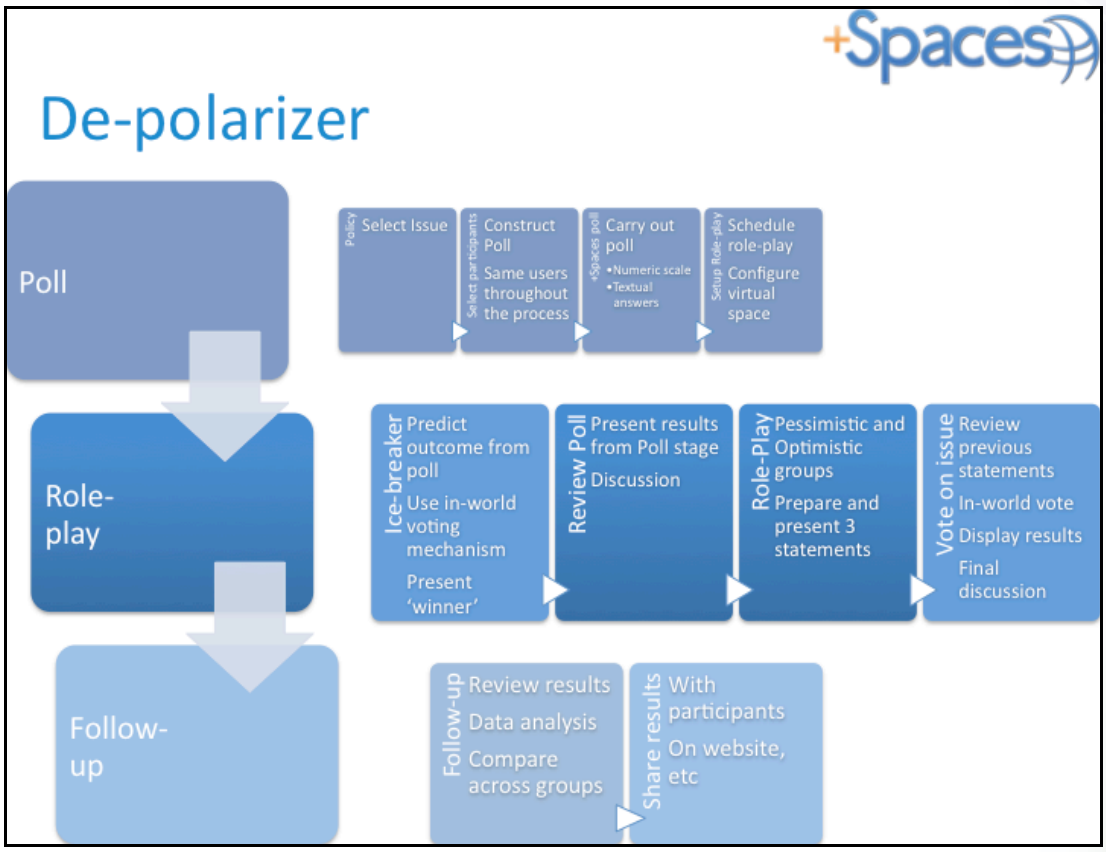


Figure 5

Depolarizer Role-Play.

From a project perspective the benefits of using a role-play simulation approach are that it emphasises the need for inter-operability across 2D and 3D platforms, across +Spaces applications *(polls, debates, simulation)*, and with other core +Spaces services *(recommender/reputation system selecting participants, data analysis service)*. It will also provide rich data sets for the analysis services in terms of the role-play dialogue and events, and it should provide a more generalisable policy simulation framework.



Figure 6

Role-playing the Galactic wormhole template.

Conclusion

The underlying concept of the +Spaces project is that the virtual world provides a micro-society. The work of Castronova on synthetic worlds and their economies has already demonstrated that user behaviour in virtual worlds mirror those in the real world *(Castronova, 2005; Castronova, 2008)*. The objective of the +Spaces project is to engage with users in these virtual spaces and discover their real responses to simulated situations. Creating computer-based simulations can be very complex, and existing game-based simulations are typically closed environments that cannot easily be re-purposed. It is also difficult to reuse the underlying models to construct a new simulation. For these reasons role-playing provides a more tenable and reusable framework for 'simulating' government policy. In a role-play the virtual space provides an environment in which the participants themselves can act out a particular government policy issue, mediated by an online facilitator. The role-play could take place in a virtual space that visually recreates the location of the intended policy. The +Spaces project is building on previous work on using serious game role-play environments to construct a unifying framework that ties all of these elements together.

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An Alternative (to) Reality

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Abstract

This paper proposes that the generation of successful virtual environments relies on better understanding of how we conceive virtual and physical realities in our consciousness. In particular, to recognise that our conception of these realities is more importance than our perception of them. The failure and success of certain virtual environments are explained as the failure and success of the application of these phenomena.

Firstly, making use of philosophical phenomenology, our understanding of physical reality is considered in terms of phenomenal conception and it is shown that objective perception is only one part of our relationship to physical environments. Secondly, the other point of view is considered and virtual environments are argued to be just as valid phenomenal conceptions as their physical counterparts.

Finally, the translation of phenomenal conceptions between realities is considered, providing a different way of considering how we think about and design all types of reality. Several interesting potential avenues of investigation are identified and examples of the emergence of this approach are presented.

Introduction

Virtual Reality has become a recognisable phrase often referring to environments generated and hosted electronically, but the word virtual leads to natural conclusions about the nature of these 'places'. Virtual suggests simulated, copied, mimicked - that there is an a priori reality that is the thing of value and that the virtual version of it must therefore be nothing more than a simulacrum.

Virtual Environments *(VEs)* come in a variety of forms, from collections of information that generate a social body of knowledge *(such as a Virtual Learning Environments (VLEs)* or Wikipedia) to Multi-User Virtual Environments *(MUVEs)*, such as Second Life *(SL)* where a computer generated 3D graphical representation of an environment is provided, within which a user can navigate and interact with the environment and other users.

The word virtual in all of these terms is the starting point for this paper and it is suggested that, by using it, we immediately frame the environment in terms of a duality – that there is a 'real' world and the virtual, and that the latter is in some way a copy or simulacrum of the other.

The tendency to use VEs to simply copy physical reality is well documented *(Addison & O'Hare, 2008; Gardner, Scott, & Horan, 2008; Grove & Steventon, 2008)*. There is also evidence to suggest that we do not use this new technology to its full potential *(Hobbs, Gordon, & Brown, 2006; Hollins & Robbins, 2008)*.

It will be argued that copying reality and unfulfilled potential are symptoms of the same thing – that the essential part of how we conceive of any environment is not properly recognised. It is proposed that this essence is the phenomenal conception we generate from an environment and not simply the perception or cognition that arises from it.

Let us begin by posing the question 'Why do we use gravity in virtual environments?' This apparently simple question may seem a strange starting point and, with a little thought, may also seem to be answered quite simply. But there is potentially another way of looking at this question, which also provides another way of looking at all realities, whether virtual or physical.

Physical reality as phenomenal conceptions

A brief introduction to phenomenology

Bachelard *(1994)*, in The Poetics of Space, describes architecture in a phenomenological way, providing us with a vivid alternative view of how we conceive the physical world around us. Rather than simply viewing our environment as a series of *(objective)* objects, we are constantly interacting with it – interpreting, filtering, or applying value. The ultimate idea we have of reality is very different to any objective measurement we may make of it. Bachelard presents a phenomenological view of architecture *(and of reality itself)*.

Philosophical phenomenology, as originally formalised by Edmund Husserl *(Honderich, 1995)*, considers the difference between the thing perceived in our environment and the thing in the mind. More importantly, we must realise that the perception of anything is necessarily subjective and relies on both the thing itself and our cognitive interaction with it.

Heidegger develops this in greater detail with respect to our interactions between perception and cognition. We may see a thing, but once we have interacted with it, we have a different relationship with it. The interaction in itself has developed our idea of the perceived thing and this in turn affects our relationship to it. Both Husserl and Heidegger rely on a duality of *(at least)* perception and cognition – i.e. that the perception of a thing occurs by a consciousness and becomes an idea in the mind.

But it was Merleau-Ponty who synthesised this duality to suggest that neither should be considered a priori *(Merleau-Ponty, 1962)*. For Merleau-Ponty, both must be considered as a single embodied entity – our perception of a thing and our cognition of it are at once the same thing, separable only by definition *(if at all)*. When we touch something, we actively conceive of it as we interact with it.

It is this embodied phenomenology that is of greatest interest in this paper, although it is still perfectly possible to apply these arguments to a dualist position.

This is a *(very)* brief description of the main points of philosophical phenomenology. Fingelkurts et al. *(2009)* is worth reading for an expanded *(and much better)* summary.

Architecture as phenomena

Returning to Bachelard, he provides the examples of cellar and attic as two very different conceptions of place in a house:

> *"Verticality is ensured by the polarity of cellar and attic, the marks of which are so deep that, in a way, they open up two very different perspectives for a phenomenology of the imagination." (Bachelard, 1994)*

Bachelard is suggesting that there is something very different in our conception of going up to an attic when compared to going down to the cellar. We do not only perceive the attic and cellar, we react to them as very different objects with different values attached. For Bachelard, the phenomena of attic and cellar are the 'real' events – not the physical objects themselves.

All architecture can be considered in this way, from the feeling of entering a building to how we react to a particular shape of room. The conception we have of space generated by built form is where the architecture happens. As Clark & Maher *(2001)* suggest, Architects create space – people bring Place – and it is Place that is argued to be most important part in terms of human interaction and understanding. In architecture, this is sometimes referred to as genus loci *(Norberg-Schulz, 1980)* and the meaning that Place can embody in architecture has been discussed and used by many architects throughout history.

Aside from the philosophical argument, the fact that we respond cognitively to buildings is a well documented phenomenon *(see Anthes (2009)* for some interesting examples) – particularly when a physical and cognitive map do not align *(Carlson, Hölscher, Shipley, & Dalton, 2010)*. What is important in all these examples is the requirement for people to generate the meaning.

It is worth noting here that this is perhaps one of the reasons why superficial copying of physical reality does not always translate as expected to VEs. It is possible to copy the elements but if the conception of these is not translated then a different phenomenology can occur – the triggers of the 'value' of a physical place must be translated as well, and these triggers are not always the simple physical elements.

Reality as phenomena

It is also possible to extend this idea to events that may not seem to be traditional forms of architecture. In fact, it is argued that reality is effectively 'virtual' when considered from the point of phenomenology. If we realise that the thing conceived is not the same as the thing perceived *(for dualists)* or that we require conception *(for embodied theorists)* then we must accept that truly objective reality cannot exist *(see Fingelkurts et al. (2009)* for an interesting view on this).

This is not simply a philosophical or phenomenological construction – the difference between the objectively measured reality and our perception of it is well documented. A simple example is the finding that we do not see colour the way it exits physically *(by objective measurement)* and that it can be influenced by cultural conditioning *(Lotto, 2004)*. So we must consider that, if we cannot even agree on seeing red, our idea of physical reality is at least as much an idea as it is an objective reality. In short, physical reality is nothing more than virtual anyway.

Virtual Environments, information and education as phenomenal conceptions

Virtual Environments as phenomena

We now consider our relationship with VEs and argue that similar conceptions of these 'places' are formed in our minds. This can be demonstrated directly from the arguments above. We copy physical reality in VEs since we understand them to be a translation between physical and virtual and, generally, we observe that many of the conceptions formed in physical reality can also be formed in VEs. For example, we generate physical 'rules' to maintain analogies - we make sure avatars cannot go through walls, we have gravity, we make use of spatial arrangements that make sense in terms of physical reality.

We are, in effect, providing conceptual environments – ones that makes sense to us in terms of our interaction with them. The simple physical elements of a VE can come together to form something that is greater than the sum of the parts and a sense of place can be achieved *(Doyle, 2008)*. Moreover, in an educational context, this sense of place seems to be an important aspect of the richness required in a MUVE *(Clark & Maher, 2001)*.

MUVEs can clearly allow social conceptions to exist, with communities forming and social interaction taking place *(see Twining & Footring (2008)* for one of many examples of this). Even negative aspects of any socially organised system can be found – see *(Carr, Oliver, & Burn, 2008; de Jong-Derrington & and Homewood, 2008; Minocha & Tungle, 2008, for several examples.*

None of this would be possible without a conception of the MUVE – something that is greater than simple perception of the objective reality being presented is only possible when it is conceived.

Information as phenomena

It is now argued that information can generate a conception. On the simple level we could argue this from the fact that perception is information and this will automatically lead to conceptions of that information being formed. It is extremely difficult to conceive of data in isolation, without giving it meaning. To say that a thing is 'two' makes very little sense unless we apply that data – i.e. that we have two things, or that two things relate. In each case we generate a relationship to construct a conception of the information and its meaning. Tim Berners-Lee refers to 'the information space' *(Berners-Lee, 1999)*, clearly indicating what we know intuitively – data has value only when a conception of it is created to give meaning and sense *(in this case, a spatial/ relational meaning)*.

For example, we naturally represent a value's magnitude in geometry by a line 'rising' or a data point becoming 'larger'. This might seem a truism, and in many ways it is – our 'natural' understanding of lower and higher will automatically be applied in an analogous way to anything we conceive of as having magnitude. But we need to recognise how many other things we apply the conception of lower and higher to and recognise this as a direct analogy to Bachelard's going 'up' to the attic and 'down' to the cellar. The information itself is given meaning by our conception of it.

In fact there is a growing tradition of interpreting abstract data in a visual or phenomenal way. Rosling successfully demonstrates how we can re-interpret data when we look at it interactively *(Ted Talks, 2006)*. We Feel Fine *(Harris & Kamvar, unknown)*, takes blog postings starting with 'I/ we feel…' and visualises them, providing the user with an interactive space to experiment with this data. In doing so, a user will develop their conception of the data and ultimately the meaning of it from this conception.

This meaning and conception is important. Stories, for example, are nothing more than information, yet they create very vivid conceptions in our minds. Some of the earliest human communication was representative and descriptive. A cave painting of an animal is clearly not the animal itself; rather, it relies on the viewer conceiving the representation being made. All storytelling relies on a conception of the information being presented and we are asked by authors to imagine, project or immerse ourselves in this conception. Modern storytelling continues this tradition but it relies on the same principle. Dreams of Black *(Milk, 2010)* presents an HTML5 example of modern storytelling where an interactive VE and traditional storytelling combine. And what of Shakespeare in Second Life *(Chafer & Childs, 2008)* – is the story or the medium the conception being created?

It is also possible to imagine other information repositories as 'places' of information. Peachey *(2008)* refers to Oldenburg's 'third places' in MUVEs, and cites Glogowsky as suggesting that an online blogging community can also be viewed as such a 'place'.

Here, information is suggested to generate some conception that is beyond the mere interpretation of the information itself and many educators will be aware of the need to generate an 'atmosphere' or 'momentum' in a VLE forum. If information in this context is not a conception, then how is it that we can even conceive of an 'atmosphere' when we refer to a series of letters and colours in a forum?

Education as phenomena

Education can be argued to rely entirely on the generation of conceptions. In fact, information transfer is arguably the least part of education. Problem Based Learning, Constructivist Learning or Personal Learning Environments are all examples of approaches to education that focus on the generation of conceptions in the mind of the student. The transfer of information is of a lower priority to how that information may be used or how meaning may be derived from it – and there is some evidence that VEs are suitable environments for this *(see 4.1 below)*.

It is worth noting that this is certainly not limited to VLEs or MUVEs. We can all reflect on physical learning events that have stayed with us throughout our lives and might recall a specific teacher at school, a particular subject *(or even concept)* and certainly the sense of place. In each of these memorable cases, it is argued that the phenomenon is the thing remembered. Ramondt *(2008)* discusses the 'gift of drama' in education and how a teacher can generate conceptions in learning rather than simply presenting information.

There is something about doing that is important – that goes beyond being a passive observer. The direct analogy in education is that, if we seek to develop more than the simple transfer of information, then we need to provide more than data. The creation of conception requires richer elements of learning. The conception of physical reality, VEs or even information relies on interaction and this does not have to be direct mimicry physical reality. As Hollins & Robbins *(2008)* state, *"After all, all computer use is interactive."*

Synthesis of physical and virtual

If we accept that we can consider physical reality, VEs, information and education in a phenomenological way, then we can translate conceptions between these environments'. Moreover it allows us to start with and focus on the phenomena or conceptions themselves – but we do need to understand the difficulties in doing so.

The barriers to phenomenal design

There are good reasons why we do not just jump straight into an abstract reality made from conceptions. Design for VLEs and MUVEs require just as much attention as their physical counterparts and in many cases these considerations are more important to ensure a reasonable translation of the design intent.

We know that students require induction to understand how to relate to MUVEs *(Addison & O'Hare, 2008; Trinder, 2008; Truelove & Hibbert, 2008)*. Similarly, the challenges facing MUVE socialisation design are known *(Minocha & Tungle, 2008)*, and simply translating 'rules' from physical reality to VEs can be difficult *(Barker, Haik, & Bennett, 2008)*. But in each of these cited examples, evidence is also presented of how these problems can be managed or overcome. Once a conceptual framework is embedded there are genuine benefits to be gained and people can adapt to these new environments.

In fact, as Carr et al. *(2008)* notes:

> *"A degree of disorientation or ambiguity might be productive in one learning context yet completely counter-productive in another."*

And

> *"The 'anything goes' nature of SL meant that our students took little for granted. For example, they questioned the various pedagogic decisions that had been made."*

Moreover, it is often the challenge of the new environment that is the reason for it being created. In computer gaming, there are several examples of entire games generated around radical shifts in conceptions of physical reality. Portal *(Valve Corporation, 2007)*, The Company of Myself *(Piilonin, unknown)*, and Shift *(Armor Games, 2008)*, are all examples that not only require the player to adapt to a different conception of the reality they are presented with, but require the player to actively engage with that conception in order to progress the game. In effect, the method and mode are synthesised into a phenomenon – an embodied event of conception through interaction.

But we do need to attempt these challenges for several reasons:

- The formation of these places can be emergent *(Minocha & Tungle, 2008)* and this emergence is already occurring. We naturally design phenomena but often at an instinctual level without understanding or recognising it explicitly. Being able to consciously design for the emergence of phenomena, or at least being aware of this mechanism, is required. The failure of physical copies of campuses in MUVEs is an example of the failure to translate the phenomena of those campuses.
- Designers are working beyond their 'expertise' and this, rather than being a negative outcome, is leading to some genuinely excellent inter-disciplinary solutions. This knowledge needs to be recognised and shared with further lines of design investigation followed. In fact the potential this may offer may be only now truly emerging.
- If we aim for student centred and adaptive pedagogies, then we must consider the affordances of conception based *(MU)*VEs. Problem Based Learning has been demonstrated to be possible *(Brown, Gordon, & Hobbs, 2008; Burden et al., 2008; Burton & Martin, 2008)*. Constructivist Learning may operate more effectively in an MUVE *(Grove & Steventon, 2008)*. Atwell's Personal Learning Environments *(Attwell, 2007)* are effectively conceptions of learning places.

There is also a self-referencing argument to be made with respect to educational *(MU)*VEs. It is all very well starting with pedagogy but if we do not know what is possible with a new mode we have no way of realising how a pedagogy can be applied *(or even affected)* by its use. A very good point is made by one of the educators interviewed in Minocha *(2010)*:

> *"I find the political correctness of 'pedagogy must lead technology' to be rather sterile. We need to be more interactionist about this. The teachers don't know what is possible [in SL], and the technologists don't know what the teachers might want to achieve if they could…'"*

Perhaps our design of these places needs to learn from the duality of early phenomenology – that both should collapse to a single conception of mode and pedagogy. After all, if we acknowledge that the creation of conception requires interaction *(e.g. application of theory and practice)*, then we require an embodied pedagogy that does not assume a simple cause and effect model of education – we require an emergent pedagogy where the method is the teaching and vice versa.

Knowledge and concept transfer

It is now argued that phenomena or conceptions can translate directly between environments, allowing exciting opportunities for designers.

For example, architectural design in education can be used in VEs and knowledge from educational VEs can be used in physical architecture. The ceiling height in physical schools has been demonstrated to have a measurable effect on creativity performance *(Anthes, 2009)*. Most notably, it is not the measurable height that generates this phenomenon – it is the conception of the space. In natural language, the more 'open' it feels, the more 'open' our minds might become.

Now consider the finding in Sweeney *(2008)*, where the removal of the ceiling/roof led to claustrophobia. Here, it was considered that the space still led to a feeling of enclosure, thought to be as result of the surrounding, windowless walls. There are obvious parallels and lessons to be learned by both physical and virtual architects in these examples and this may represent the smallest example of future study.

But we do need to remember what is common between these things – we need to recognise that it is the conception formed in our minds that is the thing of relevance. The difference between physical and virtual is typically made by considering only perception and this is insufficient to understand the whole phenomenon.

It is also worth noting that the ceiling example is as much a conceptual transfer of knowledge. It may work at a practical level *(i.e. there may appear to be a cause and effect that we can put to practical use)* but understanding the phenomenon allows us to extend its use to other knowledge domains. We now have the knowledge of how to affect the phenomenon of 'openness' and this is a very powerful knowledge to have.

We must realise, too, the potential of transfer from virtual to physical. Why not work on a real world version of the wonderful extending table *(de Jong-Derrington & and Homewood, 2008)*? We know that desk configurations have an effect on attention and work methods in schools, so how can we enable this knowledge in physical and virtual environments? What other wonderful *(MU)*VE ideas can we turn into reality?

Start with the conception

What begins to emerge from the above is that it is the conceptions we form *(the phenomena)* that are the things of interest – not the environment, whether virtual or physical. Can we, therefore, start designing with the conception we wish to convey rather than the object*(s)*?

Two brief examples of this happening already are now presented from design practice and education.

Building information modelling

In the building design and construction industry, Building Information Modelling *(BIM)*, the process of creating a virtual information model of a building before it is constructed and is changing the way designers work together *(NBS, 2011)*. BIM is effectively a MUVE and all stakeholders collaboratively place information - from the user's brief to the designer's model and right through to a final virtual building that can be used to manage the physical building itself.

The adoption of BIM in construction disciplines is rapidly increasing and it may represent a significant shift in the approach and attitude to the massive task of designing

an object as complex as a modern building *(Sheldon, 2009)*. It is this paradigm shift that is of interest here since it requires all stakeholders to share a conception of the process of design and the object of design as a single entity. The duality between the process and object designed becomes embodied to allow both to align much more naturally. As designers we seek to embody the idea and the thing together – not as separate entities.

U101 Design Thinking

U101 Design Thinking: Creativity for the 21st Century *(The Open University, 2011)* is the Open University's entry-level course for the Design and Innovation Degree. It was designed around the ides of a virtual atelier, a design studio 'space' where social, peer-to-peer student collaboration would be possible and form one of the main teaching and learning objectives. To achieve this, the module makes use of a variety of media in a blended VLE – from text, audio, and video information through to forums, shared online portfolios, and asynchronous whiteboard communication environments *(for further details see Lloyd (2011)*).

It is the idea behind the course that is of interest here and it is suggested that the conception of design as a process *(a dynamic activity)* informed the entire design of the course as well. Students are expected to engage with the idea of design as process of thought and action and this is the essence of Design Thinking *(Wikipedia, 2011)*. The duality between process and object is embodied as a single pedagogy and students are engaging with a conception and not simply a set of instructions or learning tasks.

Conception Considerations

If we start with the conception *(or phenomenon)*, there are several things we must bear in mind.

Phenomena: It is phenomena that are the essence of our relationship to any form of reality. When we make use of any information, the perceptual parts of it represent only a part of the conception we form in our minds. These conceptions are transferrable, allowing a single conception to exist in a wide variety of media and this offers an incredible variety of opportunities for the sharing of knowledge, ideas and methods. Moreover, we should not restrict our learning in only one direction – lessons in virtual design can equally apply in physical design.

Interaction: It is the interaction with *(and within)* these *(MU)*VEs that is the driver *(or enabler)* for the conception to be maintained. All participants are able to affect their environment and the sharing of consequence of change is a large part of the process itself. The interaction with *(and within) (MU)* VEs is just as important as it is in physical reality and this must be offered to users of these environments. Interaction is not simply pressing buttons or reading notes – it is the active engagement with phenomena.

Collaboration: These conceptions make use of social phenomena and in particular collective interactions. The conception is a shared entity embodied not in the *(MU)*VE itself, but in the minds of the participants. Differences of conception will arise but these are embodied in the shared event, creating the potential for interaction. Expert and novice share the same space. Not only will novices learn expertise but the expert *(with the right attitude)* can realise that expertise is not the only way to go about their specialism.

Emergence: The conception is necessarily emergent and dynamic. People are different and are constantly changing. This is an important lesson for *(MU)*VE designers – the environment you create does not 'belong' to you and you cannot easily predict how it will be conceived by users. A simple lesson from physical design can be learned here: the spaces that allow the emergence of activity *(especially those not imagined by the designer)* can often be the most successful.

Design Thinking: To design effectively in *(MU)*VEs *(and in physical reality too)* we have to recognise the above characteristics and work with and within them. This is very different to a traditional 'expert' based design method. As Lloyd *(2011)* infers, an architect may design space very well, but this is an 'architectural' solution emerging from that specific discipline. If it does not recognise the dynamic, interactive and emergent capabilities of *(MU)*VEs then it will not enable 'Place'. Design of *(MU)*VEs requires the consideration of the phenomena being generated and this calls for design thinking, not specialist design

Conclusion

When we consider reality in terms of phenomena, we realise that the conception of reality in the mind is potentially more important than any 'objective' measurement of it. Reality, as an independent object, becomes far less important than the embodied understanding of it we each have, with the values we attach to it individually and socially. A similar observation can be made when we consider VEs, MUVEs, VLEs and even information itself. In all forms of reality it is the conception we have that is the thing of importance.

Making use of conception as the starting point for design provides us with an alternative approach and process to design in general. Specialist design is only relevant as part of a holistic design thinking approach and it is these overall conceptual *(and collaborative)* attitudes that will see genuine alternative reality emerge.

We can finally return to the question 'Why do we use artificial gravity in MUVEs?' It is proposed that we do this, not to provide a simulacrum of the physical world; rather it is to provide a phenomenon – something we can interact with to provide us with a conception of reality. Gravity may help us translate physical reality into a MUVE but this is only a small part of what it really does. Without gravity in a MUVE, there is no up and down but, more importantly, Bachelard's 'attic' and 'cellar' would not exist - one of the central pillars of social storytelling would be removed and we would have no reference for the meaning of up or down in any of their many senses *(except, of course, the ones we bring with us)*.

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Wikipedia. *(2011)*. Design thinking. Retrieved August, 2011, from http://en.wikipedia.org/wiki/Design_thinking Designing for immersive learning environments across schools and science museums

Designing for immersive learning environments across schools and science museums. Multi-professional conceptualisations of space

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Abstract

Conceptualisations of space are central in the design of mixed reality learning environments. Notions of space as place consider not only physical, but also experiential, social and cultural dimensions. Designing immersive learning environments often involves multi-professional collaboration. In such teams, collaboration between partners is of vital importance. With Cultural-Historical Activity Theory (CHAT) as a theoretical lens, we understand teams as mediated, object-oriented activity systems. To understand the process of the design work, we focus on the negotiations in the design team. Using video-recordings of workshops we explore how notions of 'space' are co-constructed in the design process. 'Space' emerges as a shared object that triggers negotiations of the different understandings. It is argued that a design strategy that includes understandings of the design process as a situated, socio-cultural process, allows for innovative implementations in immersive learning environments.

Introduction

This article is concerned with designing immersive learning environments in science education across schools and museums. The project Mixed Reality Interactions Across Contexts of Learning *(MIRACLE)* aims to increase the students' interest in and conceptual understanding of science by connecting learning activities in science education at upper secondary schools to activities at a science museum, making use of technologically enhanced physical spaces. In this paper we present an analysis of the multi-professional design of a mixed reality learning environment in a science museum setting. Our approach, consistent with the socio-cultural idea that all human interactions unfold as embedded in situational contexts, addresses the following research questions:

- How is concept 'space' constructed in a multi-professional team?
- What tools mediate negotiations of immersive learning environments?
- Space and place as key concepts in mixed reality environments design

Since Harrison and Dourish's *(1996)* influential work, notions of space in the field of information technology and systems design have increasingly been extended from considering space as a physical structure of the world that organises interaction, to reflecting on spaces as experienced places that afford meaningful human action. The concept of place arises from the realisation that our behaviour within space cannot be explained exclusively by the physical spatial arrangements of matter around us. It refers to 'the way that social understandings convey an appropriate behavioral framing for an environment' *(Dourish, 2001, p. 90)*. Such social understandings entail cultural meanings that frame the range of behaviours spaces afford and the range of behaviours that they do not afford, beyond what the physical space actually makes possible. Three main ideas are of relevance for the conceptualisation of place as elaborated by Harrison and Dourish. The first is an understanding of place as experienced, an idea that stems from the phenomenological tradition of thought *(e.g. Merleau-Ponty, 1945)*. The second one is the understanding of space as affordance. The concept of affordance stems from Gibson's

ecological psychology *(Gibson, 1979)* and refers to the relation between an organism and its environment in terms of how the properties of the environment afford certain actions that the organism has the capacity to perform. Space is a possibility, but it is also a constraint. The third one is the recognition of socio-cultural meanings involved in any situated action within space *(Lave, 1988; Suchman, 1987)*.

Mixed reality, or hybrid environments, involves the distribution of computational devices across the physical space, whether these are part of the structure or are embedded in it. Thus, considerations of the physical space become a critical aspect in the design of such environments. Interest on implementation of hybrid environments has increased in recent years *(Hall et al., 2001)*. One contemporary context where this kind of implementation is conducted and researched is the museum *(e.g. Bannon, Benford, Bowers, & Heath, 2005)*. In order to promote learning and engagement, technology and media have been adopted by museums and science centres often following two key ideas: immersion and interaction *(Stickler, 1995)*. Immersion is 'the subjective impression that one is participating in a comprehensive, realistic experience' *(Dede, 2009, p. 66)*. Considering that the notion of place introduced here involves physical, subjective, social and cultural dimensions *(Ciolfi & Bannon, 2005; Tuan, 1977)*, design of immersive learning in hybrid spaces must account for all these levels. Studies considering notions of place as a design concept for hybrid environments in museum contexts *(Ciolfi & Bannon, 2005, 2007)* introduce valuable design frameworks and include fieldwork studies in order to gain insight about how the spaces are actually experienced by different individuals. These studies contextualise and situate the spaces as experienced. However, these studies do not contextualise and situate the design process itself. The aim of this paper is to contribute to the understanding of place in design by identifying and analysing how different perspectives converge, and meanings of space are negotiated in multi-professional design work. Drawing on Cultural Historical Activity Theory *(CHAT)* we conceive conceptual issues involved in the design process not as something pre-structured in theoretical knowledge, but as achieved in the course of activity and interactions *(Engeström, 1987)*.

A CHAT approach to collaborative design

Designing an immersive learning environment in a science museum involves the arrangement of multi-professional work teams. In such teams, collaboration between partners is of vital importance, and has to be understood as a learning process. To understand the process of design and development work, it is therefore necessary to empirically focus on negotiation between the partners in the design team. With CHAT as a theoretical lens, we understand teams as mediated, object-oriented activity systems. With the notion of object, CHAT not only seeks to understand what people are doing, but also why they are doing it. 'Why' questions can be addressed by analysing the motives of object-oriented activities. The notion of object refers to two different, but interrelated, aspects: the historical, generalised object of the activity system *(which in our case is the design of immersive learning environments)* and the situational, constructed object that gives direction to the *(inter)*action *(for example the term 'space') (Jahreie, 2010)*.

According to CHAT, contradictions are seen as the driving force of learning and change in and between activity systems *(Engeström, 2001)* and have to be seen as a potential for the design process. When studying collaboration in a multi-professional design team, boundaries are a key concept. From the perspective of CHAT, boundaries are part of activities and have historical layers. Boundaries are intrinsic to the activity system, but become transparent in and through participants' talk and action *(Kerosuo, 2006, p. 4)*. In crossing boundaries, participants encounter different and sometimes conflicting views; thus, processes of collective concept formation are imperative. The space in-between activity systems become a potential for participants from different activity systems to negotiate new meanings that go beyond the boundaries of both *(Engeström, 2001)*. We define this space as a defined border zone

(Kerosuo, 2006). Like boundaries, border zones evolve with participants' actions, and depend on at least two interactional aspects: the participants become positioned and position themselves to question the norms and rules of activity systems, and they co-construct shared objects *(Jahreie & Ottesen, 2010)*. In this study, we analyse workshop interactions to investigate how border zones emerge in object construction.

Context description and methods

MIRACLE is related to an exhibition on energy hosted by the Norwegian Museum of Science and Technology called 'Energy for the future'. Energy is one of the main themes in the curriculum for the upper secondary freshmen year. Heat pumps, which we focus on in the first out of three iterations, are one of the central subthemes *(KD, 2010-2011)*.

The core tools in the design process in this first iteration are the development of a pedagogical plan, a technological plan and a museum exhibition plan. These plans are developed as a parallel course, but relate to each other. The participants have responsibilities for different plans, which are discussed and negotiated in the workshops. In workshop V, from which the main data is gathered for this paper, the focus for discussion was mainly the exhibition plan, though it was seen in relation to the two other plans. In previous meetings of the research group, heat pumps were selected as a first thematic focus. One of the proposed exhibits to represent a heat pump involves a bicycle that would be connected to a digital interactive representation of the mechanics of the heat pump. As visitors bike, they feel the handlebars change their temperature: one increases while the other decreases. This interchange of temperature is a key aspect of the heat pump, and it is dependent on several variables, such as compression and expansion. The visitors can explore and modify different parameters interacting with the model. During the sessions included in this paper, the exhibit is still under consideration.

MIRACLE is inspired by the design experiment tradition *(Brown, 1992)*. In general terms, this implies that we will design for educational interventions that are arranged in an everyday setting where digital technology bridges the school and museum, and then conduct studies of how these stimulate students' knowledge construction. This is a complex design process motivated by a set of workshops with different relevant stakeholders such as museum conservators, exhibition designers, researchers, scientific programmers, teachers, and animation specialists, and it also involves the study of previous research *(see Jahreie, Arnseth, Krange, Smørdahl, & Kluge, submitted for a review)*. In this article, it is the situated nature of the design process, which we are focusing on.

The study is based on observations from the first ¾ year of the project *(October 2010–June 2011)*. During this period, we conducted five workshops. Workshops I-IV are used for ethnographic contextualising data *(Jahreie, 2010)* and are central to the socio-historical analysis. All workshops are video-recorded and constitute fourteen hours of recordings. The analytic work was conducted in three steps. First, we constructed an overview of the total corpus of data in order to select a subset. Second, we conducted an initial analysis to identify recurring patterns of interaction. In the ethnographic analysis of the socio-historical development of the project, we identified two recurring themes, as developed in the following section. In workshop V, we were able to identify the first instances of boundary crossing and selected them as the core data for this paper. Workshop V is documented in 5 hours of video recordings. Two excerpts extracted from workshop V are selected for deeper analysis because they display instances of boundary crossing in relation to the two recurring themes. Our analysis builds on interaction analysis *(Jordan & Henderson, 1995)*. By examining the participants' approaches, reasoning and actions, we aim to uncover how the notion of 'space' becomes a shared object in the interaction and how this opens occasions for transforming the boundaries between the activity systems. Workshop V was held in English. It is important to note that most of the participants are non-native speakers of English. The transcripts have, however, kept the original elocutions.

We as researchers as well as our colleagues are participants in the group that we are studying. This is an issue about which we need to be careful. Our own voice should

not be biased compared to other voices presented. Practically, this means that we are not looking for some kind of normative idea about the right meanings of how to design and develop learning activities in science, but rather to identify how they negotiate with central themes in the design work. We have used our socio-cultural research community to qualify the objectification of our analysis to make sure that we deal with the different voices equally.

Empirical analysis

Socio-historical development of negotiations in the multi-professional team

The initial analysis revealed two recurring themes present in the negotiations in workshops I-V: The first was experience versus reflective aspects of learning, and the second was the knowledge domain of energy. Our initial analysis of experience and reflective aspects of learning as a recurrent topic confirms our findings from workshop I *(Jahreie & Krange, 2011)*. The participants orient their attention towards the same historical object, designing learning activities across schools and museums, but there is some tension in the conceptualisation of the generalised object. The museum conservators are inclined to perceive learning in terms of interactive experience, the architecture designers in terms of emotional involvement, and the university researchers as conceptual understanding. This is not surprising, but what is important, is that the different conceptualisations were mostly seen as separate, and the integration of these concepts across schools and museums remained as a challenge.

The next topic is related to the fact that energy as a theme, involves both scientific and socio-politic issues. Both issues are part of the curriculum *(KD, 2010-2011)*. This topic has been repeatedly discussed and negotiated around the heat pumps sub-theme during the workshops. In the negotiations, we found that the exhibition designers did have problems in finding the scientific issues of the heat pump relevant for the design of the museum space, since these were in their view neither attractive nor relevant to the whole concept of energy. The researchers, on the other hand, showed concern over fostering students' conceptual understanding of scientific aspects, paying less attention to the socio-political issues. Finally, museum curators clearly showed sympathy for the idea of including scientific-related curriculum issues, but often problematised the heat pump theme for being too complex to be understood beyond its socio-political dimension. What is interesting in this discussion is that the participants often talk about scientific and socio-politic issues as separate issues, and thus their interrelation in the design layout becomes yet another challenge.

In this ethnographic contextualisation, we also identified different orientations to the two recurring topics. As indicated in our first study of the design process, these differences have to be understood in relation to conflicting object-motives between the activity systems *(see Jahreie & Krange, 2011)*. Through the lens of CHAT, this situation can be identified as involving inner contradictions *(Engeström, 2001)* between different conceptualisations of the generalised object of designing for learning activities on the one hand, and between understanding how the knowledge domain should mediate the object, on the other. Until workshop V, the participants tended to defend their orientation, grounded in their motive for participating and the division of labour in the multi-professional group. In the following sections we examine how discussions on 'space' constitute a turning point where the boundaries are transformed.

Excerpt 1: 'Space' as a shared object

The following excerpt is taken from a presentation of the architecture firm. One of the two exhibition designers presents a draft

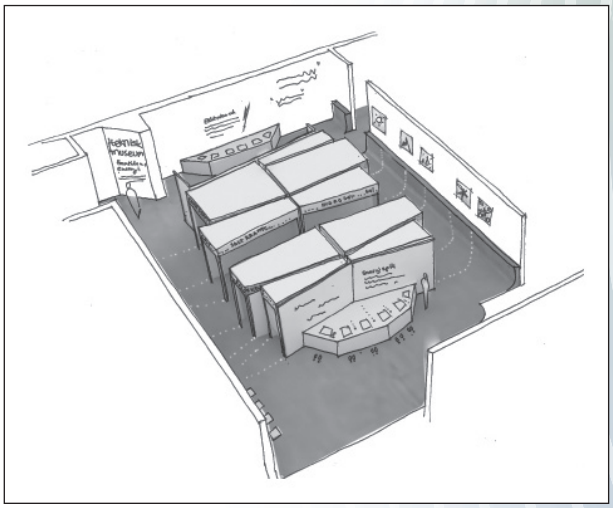


Figure 1 Plan floor for the exhibition room.

of the floor plan for the exhibition space. The plan is displayed during the presentation. The room it depicts is square and covers 120 m2. It is a small space for an exhibition, which makes it challenging for the architectural design. The solution suggested by the designers proposes a corpus of modular walls set at the centre of the room, forming a number of semi-cabinets *(Figure 1)*. The cabinets would host the different exhibits, individuating each one as unique.

At the same time, because they are not closed, the cabinets are still communicated with the rest of the room. Apart from a lack of space in the room, the designer highlights two other proposals. One is related to the interactivity of the room: 'When you enter an exhibition, you want to meet eyes; you don't want to meet backs. We wanted to focus the exhibition to the core of the space, and not to the walls.'*(exhibition designer during plan presentation)*. The other is related to the challenge of relating the different subthemes of the exhibition to the overall 'future of energy' theme. Thus, a number of solutions are directed to increase the sense of unity. The space dedicated to each exhibit extends beyond the cabinets up to the external walls of the room, and a single material is used for the entire floor and up to the walls. The draft also considers the possibility of media projections on the external walls streaming from each cabinet, so that what is going on within each exhibit is shared or reflected in the open, shared space.

5. Researcher 1: One comment. Eh, I liked very much what you said in the beginning with the, eh, not seeing all these backs. When you come into a space, you see only the back heads of people who are working... But still this is a kind of box... like a black box things set up. Could it be an idea to have some kind of transparent, eh, transparency there? Because you have issues, each, eh...
6. Exhibition designer: We are talking about using these corridors [*pointing to the screen*]of course here is a physical corridor where you can walk in, you see people that you've seen before... which is...
7. Researcher 1: ...Because it could also be an illustration of that it's not only one solution. It's not only sun or only wind, it's a common thing and there are certain different things.
8. Exhibition designer: Yeah, and how you connect this one, this one and this one (pointing to the different cabins) when you make a transparent window in between and we start using mirrors, where you instead of projectors use mirrors to...
9. Researcher 1: Because one thing we thought about is also to have a projection, if you combine this bicycle idea with a projection, it could be interesting if people also are in the other side, so you see kind of semi-transparent projector material that you can look from different sides.
10. Researcher 2: A double-sided screen.
11. Researcher 1: Yeah
12. Curator 1: It's possible on that wall, but not on the other wall.
13. Exhibition designer: Which one is that and which one is the other?
14. Researcher 1: It is not possible in the walls around...?
15. Curator 1: Is this one... [*Pointing at the powerpoint*]
16. Researcher 1: Ok, so then it's possible
17. Curator 1: And ... and this one is facing, facing out into the science center. And this one is facing into a corridor for the engine room for the elevators.
18. Researcher 3: Because if you think of this as a kind of an extension of the science center now, it will kind of have the same feeling, what it's in this space ...
19. Curator 2: It will have, it will be all interactive, but it will have a different form. And it will connect to this big master plan of the future energy... so it will be part of that.
20. Researcher3: Yeah

Figure 2 Excerpt 1.

After a 15-minute presentation, the participants discuss the exhibition concept. The matter of how the cabinets are related to each other, how they are related to the rest of the room, and how the room is related to the rest of the museum becomes a topic. In the excerpt below *(Figure 2)* they discuss the opportunity of having transparent, interactive walls.

The sequence starts with researcher 1 acknowledging the idea of the exhibition concept. However, he is concerned that the room will turn into a 'black box', and asks if it is possible to have some transparent walls. It is not clear whether he suggests this idea as a means to communicate between cabinets within the room or as a means to communicate with adjacent rooms. However, the exhibition designer explains the thoughts behind the design without going into the idea of transparency. He is interrupted by researcher 1 who explains that transparency would be a good idea to show that energy is neither only solar power nor only wind power, but are related *(turn 7)*. He thus returns to the designer's challenge of integrating the sub-themes. The exhibition designer acknowledges the idea of transparency and elaborates on it, taking for granted that researcher 1 was talking about transparency between cabinets. In turn 9, researcher 1 brings in another dimension, arguing that transparency makes it possible to look at a projection of the exhibit from different sides. He is supported by one of the other researchers. Curator 1 comes into the conversation and they discuss some practical constraints of on which walls it is actually possible to implement the transparent screens *(turns 12–15)*. We see that curator 1 focuses on the possibility of using transparency of linking the room with other parts of the museum, such as the science centre. The discussion turns into the idea of linking the room with other parts of the museum, and researcher 1 seems to comply with it. In turns 18–20, researcher 3 and curator 2 highlight potentials of this possible solution in regard to the implications it would have both for the visitor's experience and for their interactivity: people would experience a smooth transition between environments in the museum, and their activity will continue framed within an interactive space.

There are two aspects worth highlighting. The first is how the term 'space', made available by the plan's presentation, becomes a shared object around which all participants reflect. Through the conversation, the term 'space' is regarded as an affordance for interaction, both with other people and with the exhibits. Second, we see that even though they co-construct a shared object at the border zone between the activity systems, the means and motives for constructing the object vary according to the activity systems. Thus, in the discussion we see three approaches to how space affords interaction. The exhibition designer approaches it by means of architectural resources, such as 'mirrors', for fostering interaction among the visitors. The researcher on their end, approach it with a technology-based solution, for example using projectors to foster interaction around the exhibit. The curators' approach it as a means to situate the new exhibition in relation to the science centre and other parts of the museum, thus enacting their main motive: the museum as a whole.

An additional finding is that the room's space, understood as an affordance for interaction, mediates an integrated understanding of the knowledge domain, as an interrelation of scientific and socio-political issues. All participants become concerned with keeping the diversity of topics within energy, and the topic of energy within the museum. Thus, the concept of space as a shared situational object allowed for the generation of new ideas about how to design for thematically linking the different parts of the museum, affording an integral participation trajectory within the room and across the museum.

Excerpt 2: Opening and closing of borders between activity systems

The following excerpt *(Figure 3)* is taken from a group session motivated by a presentation from the research group, where possible technological solutions were proposed. The team is divided in two groups for discussion. The aim is to discuss the proposed scenarios, and to come up with ideas on how to combine technology, the exhibits and exhibition activities. The group we follow discusses the heat pump exhibit. In a sequence preceding

42 Researcher 3: I am just wondering, you know, what we could do with this thing here (pointing to the heat pump model) in terms of engagement, embodiment, mixed reality... mmm, ways of unpucking the heat pump. [all they stare at the screen in silence for a while]
43 Curator 2: "What's going on down there?" [*pointing on the heat pump*] That's the black box. If you can put it up here [*pointing to the proposed projection connected to bicycle*], and you have some images, or a way to explaining it or show it better...
44 Researcher 3: If we discuss not on heat pumps, but on more hybrid spaces that are both physical and digital and mixed... Because that has an architectual issue, I think...
45 Exhibition designer: (long silence) Yeah, but I don't think it's from that angle. It could be anything. But I think it has to start with... Architecture is mostly sometimes in a way sight specific, as well as sight is not only into space but is also topic. And we have to work with a topic. And how media and architecture interact is not a topic. So you have to start with what issues or what target group, or... are we gonna work from or with.
46 Researcher 4: Right, so you are saying that you can't just take any old exhibit and put into that space...
47 Exhibition designer: In my world I would like to work with what story are we gonna tell, what are we gonna communicate, why are we gonna do this. And I do not work out of "Ok, I love this chair, and now I am gonna find a room where I can fit this chair in, cause that it's not how I do. Product designers work like that. And that is another angle. And is like the technical and the political...
48 Researcher 3: But could that be translated into this one (pointing to heat pump representation).
49 Exhibition designer: But this one... [staring at the heat pump model] I think, aggh ... I don't think we can do this one... (silence) Ok, we go back to the dramaturgical issue again. If we look upon this one as a hard one, that it's boring... then it probably shouldn't be in the exhibition because it has nothing to do there (laughing).
50 Researcher 3: yeah, you may be right about that, I mean...
51 Exhibition designer: So we should see how... We cannot start with fulling people into building windmills [another interactive thought for wind energy], so that they are eager enough to... And then say, "ok, now they are so happy so they will probably eat the vegetables also" [all the others laugh]. I mean... that's not how it works.
52 Curator 2: ehh, mm, seriously. We are not here now deciding what kind of exhibits will be there. And what kind of exhibits will be in the exhibition is not decided by MIRACLE, is decided by us [looking at exhitibion designer]. And, you know, it's no problem. We can rent this exhibit, if you like this exhibit, and you want to try that out, it's your choice. We have just talked of it, how we think it's difficult (...). But if you choose an exhibit which is working fine just like this, but nobody understands the principles, not even you, and then you want to see if your technological solutions can enhance that, if not even you can understand it in a simple way, then maybe your research will fail, because all you find out is that this exhibit is really hard to explain.
53 Exhibition designer: Good, good, good. My suggestion for you is really to find the core of the heat pump. What's the core. It has to be one. It cannot be many. You need a title, and heat pumps is not sexy enough. You need to have something that explains the heat pump and triggers interest. And then you have maximun three more infos on the next level. Could you explain to me what this headline is? [Pointing to the heat pump model in the screen]
54 Researcher 3: Well, I thought my headline was "how to create something warm out of something that it's really cold". (...)
55 Curator 2: "How can you warm a house in 25 degrees minus".
56 Researcher 3: Yeah. Out of a source that is actually plus four.
57 Exhibition designer: "Four degrees equals twenty two plus degrees". And the reason of this is that...?

Figure 3 Excerpt 2.

excerpt 2, researcher 3 is concerned about the complexity of the scientific concepts involved in the representation of the heat pump, and asks the exhibition designer about possible architectonic solutions. He is especially interested in how spatial features can be exploited as a trigger to visitors' reflection when interacting with the exhibits. The exhibition designer suggests the concept of 'drama' as an architectonic feature for inducing expectations. He explains that architecture cannot communicate declarative content, but it can trigger emotions. In the sequence below, the topic of architecture and drama again arises as one of the central objects of discussion.

In this sequence, the participants direct their attention to a computer screen that displays the image of the bicycle exhibit

and an interactive model of the heat pump, developed by the researcher's team. At the beginning of this excerpt, researcher 3 asks how they should get the students to understand the principles behind the heat pump by using resources as engagement, embodiment and mixed reality. Curator 2 orients his attention to the representation of the heat pump and suggests some changes that may explain it better *(turn 43)*. Instead of orienting towards the exhibit, researcher 3 turns attention to space, in terms of hybrid, or mixed realities as the problem they should direct their attention to. He is concerned about how the architectural resources can inform technological solutions. The exhibition designer replies that from his perspective it is not right to focus on how to combine architecture and technology. Rather, one should focus on the 'topic' of the space; 'sight is not only into space but it's also a topic. How media and architecture interact is not a topic' *(turn 45)*. The researcher 4 wants to ensure if he understands the designer correctly, and asks if his point of departure is not the exhibit. The exhibition designer acknowledges his question by saying that what we want to communicate, the topic, must be the focus for the architectonic design, and not an exhibit *(turn 47)*. Researcher 3 elaborates on the designer's account and asks how one could understand the representation of a heat pump from that perspective. In turns 49 and 51, we see that the exhibition designer's first thought is that it is impossible because the heat pump is too complex. Then he takes up the dramaturgical issue again, and considers how to communicate the scientific contents behind the heat pump. By making reference to another suggested exhibit about wind energy, he says that people will not 'eat the vegetables' just because they engage with an interactive exhibit. It is reasonable to interpret that he means that interactive experiences will not necessarily lead to reflection of the scientific principles *(turn 51)*. In turn 53, curator 2 interrupts the dialogue by emphasising that it is the museum that decides which exhibits are going to be included in the exhibition, not the MIRACLE research project. However, they, as a museum, can rent the bicycle exhibit 'for the experiment'. However, he emphasises that the experiment will fail, because the scientific principles behind the exhibit are so complex that not even the technological solutions planned by the researchers can enhance an understanding. The exhibition designer, however, turns the attention back to how to communicate the heat pump exhibit *(turn 53)*. In line with his previous argument on drama and topic, he challenges the others to find 'the core' or 'headline' of the heat pump model. In the next turns *(54–57)* we see that both researchers and curator actually take up the challenge, and all participants engage in trying to come up with such a headline. In turn 57, we see that the designer picks up on one of the scientific principles and asks what the reason for that is. In the remainder minutes of the session, the exhibition designer asks a series of questions concerning the principles behind the heat pump.

There are two aspects we want to emphasise. The first aspect is the tension that exists between different conceptualisations of the means for achieving design solutions. The researchers approach the historical object, designing learning activities, from a technically oriented perspective, meaning that they are concerned with how to design technological representations and hybrid environments that would mediate an understanding of the principles behind the heat pumps. The curators' approach is that good exhibits that give the visitors experiences are the core when designing the exhibition. The exhibition designer, however, approaches the object from the topic of space, bringing the issue of drama as a means of communicating to visitors. However, during the course of interaction, they co-construct the object from the perspective of the topic of 'space'.

The second aspect is related to how the boundaries are crossed between the activity systems during the interaction. In turns 45–51, the researchers and the exhibition designer crosses the boundaries by taking the others' perspective. Even though the exhibition designer is sceptical because he finds heat pumps are complex and boring, he sees this as a challenge. The curator, however, closes the possible space for co-construction by making a division between the exhibition and the research project, thus maintaining the historical boundaries between the exhibition designers and museum curators on one side, and the researchers on the other. However, towards the end of the excerpt *(turns 53–57)*, the space for negotiation is opened again and they co-construct a shared object beyond the initial boundaries.

Discussion

The aim of this study has been to explore how a multi-professional team negotiates understandings of immersive learning environments during a design process. In the first section, we introduced the concept of place as involving physical, personal, social and cultural dimensions *(Harrison & Dourish, 1996; Tuan, 1977)*. The physical space has been primarily treated as a set of affordances or means for supporting interactivity, as discussed in excerpt 1, and attitudinal expectations, as evidenced in excerpt 2. In the discussions, personal, social and cultural dimensions of space are acknowledged, as the participants talk about social interactions, feelings and expectations. However, as we come back to, the participants have different conceptualisations of the spatial dimensions.

The first aspect is that the use of the physical tools work as joint tools in the design of immersive learning environments. In our socio-historical analysis we identified inner contradictions within the object and between the tool and the object. These historical contradictions are central forces for learning and change *(Engeström, 2001)*. We found that when the exhibition plan and the heat pump model were introduced in the discussion, they worked as joint tools on which participants reflected and enacted different conceptualisations of the object, design immersive environments in the museum. Earlier studies within CHAT have provided substantial evidence on the importance of using tools, both physical and conceptual, as mediating objects to succeed in collaborative work *(Ellis, 2008; Engeström, 2007; Engeström, Lompscher & Rückriem, 2005)*.

The second point is how the notion of 'space' evolved as a shared situational object in the interactions *(Engeström, 2001)*. This had consequences for how they negotiated the historical object, design of immersive learning environments. The socio-historical analysis showed that the participants defended the boundaries of the activity systems. However, during the discussion in the last workshop we identified an important turning point when space became a shared object for their conversation. The participants still enacted the object-motives of their own professional communities, but at the same time, they negotiated these interpretations with their partners. In this process, the participants formed new meanings that go beyond borders and a border zone emerged between the activity systems *(Kerosuo, 2006)*. The concept of space as a shared object then allows new ideas for design for how to design the exhibition and how to present the knowledge domain.

The third point we want to address is contradictions between the tools and the historical object. Even though space emerged as a shared situational object, different tools mediated their approach for design immersive learning environments. For the researchers, technological solutions mediated the design of immersive learning environments. For the curators on the other hand, the exhibits worked as mediating tools. And finally, for the exhibition designers the tools they used in the design were architectonic resources, as mirrors and walls. This has to be understood in relation to the conflicting object motives between the activity systems *(Jahreie & Krange, 2011)*. However, it is important to emphasise that even though there are different tools mediating the object, the construction of the concept of 'space' has evolved during the discussion as a border zone. This can be seen as a turning point that may have important consequences for further collaborative work in the design process.

This study has implications for the conceptualisation of theoretical frameworks for design of hybrid spaces. Our findings can further future developments of technology-enhanced spaces that consider notions of place. It is argued that implementations of hybrid spaces will often involve collaborative work in multi-professional teams. Ciolfi and Bannon *(2005, 2007)* propose a participatory design strategy supported by fieldwork experience within the physical spaces' object of design. We suggest, in addition, that the generation of innovative design solutions for supporting immersive experiences in technology enhanced spaces can be improved with a deeper understanding of the tensions involved within and across the activity systems in the design process. In the same way that the notions of place lay out the socio-historical and phenomenological dimensions of being immersed in a certain space, the design process, too, is to be

understood as collaborative work between activity systems. Having shown how recurrent contradictions that arise in multi-professional design negotiations can serve as triggers for development, it is suggested that the identification of these contradictions can foster innovation in the design process.

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Effectiveness of Augmented Virtuality in Exergame on Physical Health Behavioral Intention: Moderating Role of Individualistic Regulatory Focus

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Abstract

Ever since the introduction of interactive video games such as PlayStation, Xbox, and Nintendo Wii, there has been much debate among scholars whether playing video games can influence a person's behavior. Can playing fitness video games ("exergames") motivate sedentary people to exercise? What aspects of exergames can facilitate people's desires or intentions to engage in health behaviors? The present study explores the effects of different levels of modality-interactivity-affordance in the context of exergames, involving combinations of behavioral feedback and the physical cue of userself, on game users' perceived presence, immersion, enjoyment, and physical exercise intention. This study further examines the moderating role of individuals' regulatory goal (promotion-focused vs. prevention-focused) on the game users' outcomes, and investigates the psychological mechanism underlying the relationship between the use of the augmented virtuality in exergames and physical exercise intention.

Introduction

Computer and video gaming has today become a very popular activity for children, adolescents, and even adults. Video games provide users access to entertainment or the chance to escape into a relaxing virtual world, but at the same time, they can trigger emotional involvement and reactions in game users such as aggression, joy, fear, or excitement. Recent content and technological developments—including advances in augmented virtuality and 3D graphics technologies that provide an interactive virtual world and modality-interactivity-affordance—have enabled video games to further enhance game users' interactivity, engagement, and experiences *(Fox, Arena, & Bailenson, 2009; Simsarian & Akesson, 1997)*.

Given the popularity and pervasive influence of video games, researchers and educators have naturally been interested in the effects these games place on game users. Some raise concerns that playing video games could lead to social isolation or increased aggression and/or violence, especially when playing games with violent content such as fighting or shooting, while others consider that some aspects of video games might facilitate effective learning or healthy behavior change *(Gentile & Anderson, 2003; Kirkley & Kirkley, 2007; Provenzo, 1992; Squire, 2003)*. Much of the early research on video games focused primarily on identifying the important attributes of the form and content of video games *(e.g., see Ivory & Kalyanaraman, 2007)*. Numerous studies have shown that playing video games can positively or negatively affect the cognitive and behavior responses of game users *(Anderson & Dill, 2000; Sherry, 2001; Squire, 2003)*. In addition, graphically realistic

physical cues in video games *(e.g., avatar realism and affinity)* have been shown to augment users' sense of presence, enjoyment, aggression, and arousal, as well as real-life behavioral intentions *(Eastin, 2006; Lachlan, Smith, & Tamborini, 2005; Nowak & Rauh, 2005)*.

To date, very few studies have explored in greater detail the effects of the modality interactivity of augmented virtuality-based video games on game users' outcomes of exposures, such as perceived emotions and behavioral intentions. When playing video games having different levels of interactive-modality-affordance, will users interact with games in different ways? Will a higher level of interactive modality help users better engage with video games and feel more intense emotions, and in turn, motivate user's behavioral intentions more? Will there be a correlation between psychophysiology measures and self-reported gameplaying emotions and experience? Will the type of self-regulatory goal-striving process that individuals adopt *(promotion-focused vs. prevention-focused)* translate into the virtual environment and moderate their desires or intentions to engage in actual behaviors?

The present study is intended to address the interaction of the users with the game environment and how this relationship affects their learning ability. Specifically, this study investigates whether the use of augmented virtuality in the context of fitness video games *("exergames")* facilitates game users' desires or intentions to engage in related health behaviors. This study focuses on the effects of augmented virtuality by quantifying game users' perceptions of presence, immersion, enjoyment, and physical exercise intention, while playing the exergame 'Yoga' for the Microsoft Xbox 360 Kinect, Nintendo Wii Fit, and Nintendo Wii consoles. Based on research by Jin *(2010)*, this study further examines the moderating role of regulatory goals *(promotion-focused vs. prevention-focused)* on the game users' affective self-reports and physiological responses, and investigates the psychological mechanisms underlying the relationship between the use of the augmented virtuality-based exergames and physical exercise intention.

Literature Review

Augmented Virtuality in Exergame

Augmented virtuality *(AV)* is an emerging technology that allows users to highly interact with 3D graphical interface in a real-time virtual environment. Milgram and Kishino *(2005)* coined the term augmented virtuality as a predominantly virtual environment augmented by the addition of real-world objects. AV is one of the two subsets *(the other being "augmented reality")* of the term *"mixed virtuality,"* which lies somewhere along the *"virtuality continuum"* bounded by two extremes of real environment and virtual environment, as depicted in Figure 1 *(Milgram & Kishino, 2005)*. Through interactive AV technology, video games in particular offer users a high level of modality-interactivity-affordance by providing unique features, such as combined real and virtual images,

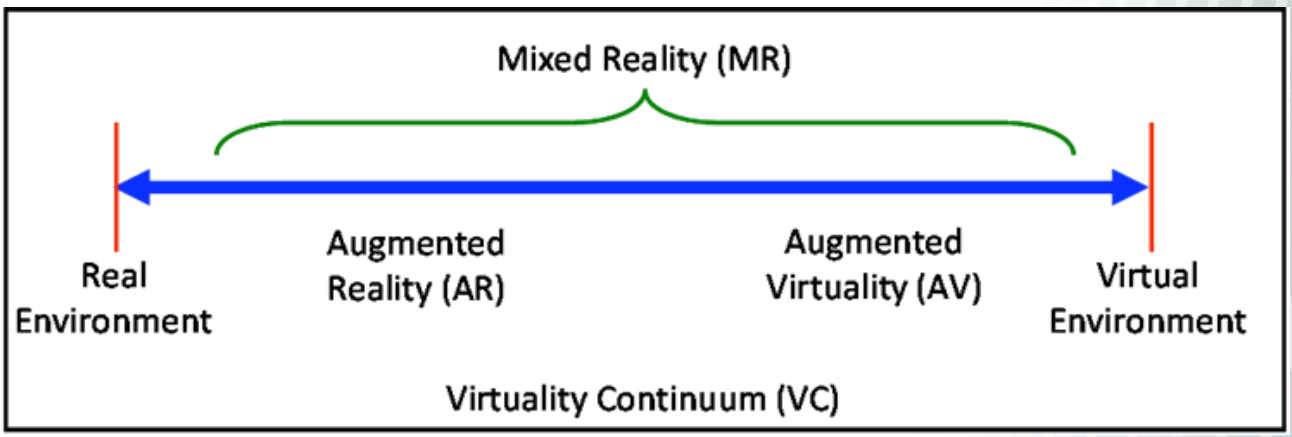


Figure 1

Simplified representation of a "virtuality continuum" (reproduced from Milgram & Kishino, 2005)

whole-body motion sensing, and real-time interactive feedback. Because a high degree of technological affordances can provide *"a learning environment that reflects the same cognitive authenticity as the domain area or environment being trained" (Kirkley & Kirkley, 2004, p. 45)*, AV-based video games are considered effective in facilitating game users' active learning and healthy behavior change

An exergame *(exercise + game)* is an AV technology-based video game that requires users to engage in actual physical body movement to manipulate the virtual characters *("avatars")* in the virtual space displayed on the screen. For example, the popular Microsoft Xbox 360 Kinect fitness games, which utilize the AV technology with a motion sensor for real-time interactive 3D gaming, provide users with visualized real-time behavioral feedback and the physical cue of userself *(i.e., showing the game user's physical appearance)*. The Nintendo Wii fitness games also provide motion-detection feedback based on game user's balance and weight or allow users to design personalized avatars that look like themselves or create their imaginary ideal self. These interactive exergames are intended to motivate sedentary people to move their whole body, and more importantly, to help them enjoy the exercise experience and do the exercises correctly when playing a fitness game such as yoga and personal training. The ultimate goal is that exergame users subsequently will engage in actual physical exercise.

Modality Interactivity and Interactivity Effects Model

Steuer *(1992)* emphasized the importance of interactivity in shaping the learning experience in virtual spaces. In his seminal work on defining virtual reality, Steuer defined interactivity as "the degree to which users of a medium can influence the form and content of the media environment" *(1992, p.88)*. Fundamentally, it is assumed that interactivity is triggered by user interaction with the interface in a two-way real-time exchange of immediate engagement and response *(Sundar, Xu, & Bellur, 2010)*. In most forms of mediated communication, medium *(or channel)*, message *(or content)*, and source are regarded as three essential elements for transmission of information in mediated communication, as illustrated in Figure 2 *(Sundar, Xu, & Bellur, 2010)*. In particular, the medium consists of a set of multiple modalities, which are the basic units of interactivity within a single medium.

Based on the model of interactivity effects as proposed by Sundar *(2007)* in his earlier paper, Sundar and colleagues suggest that *"[the sensory modalities of communication] translate into greater engagement by altering perceptual bandwidth, a concept that refers to the type and number of sensory channels involved during an interaction between media and its users" (Sundar, Xu, & Bellur, 2010, p. 2249)*. The interfaces used in modern

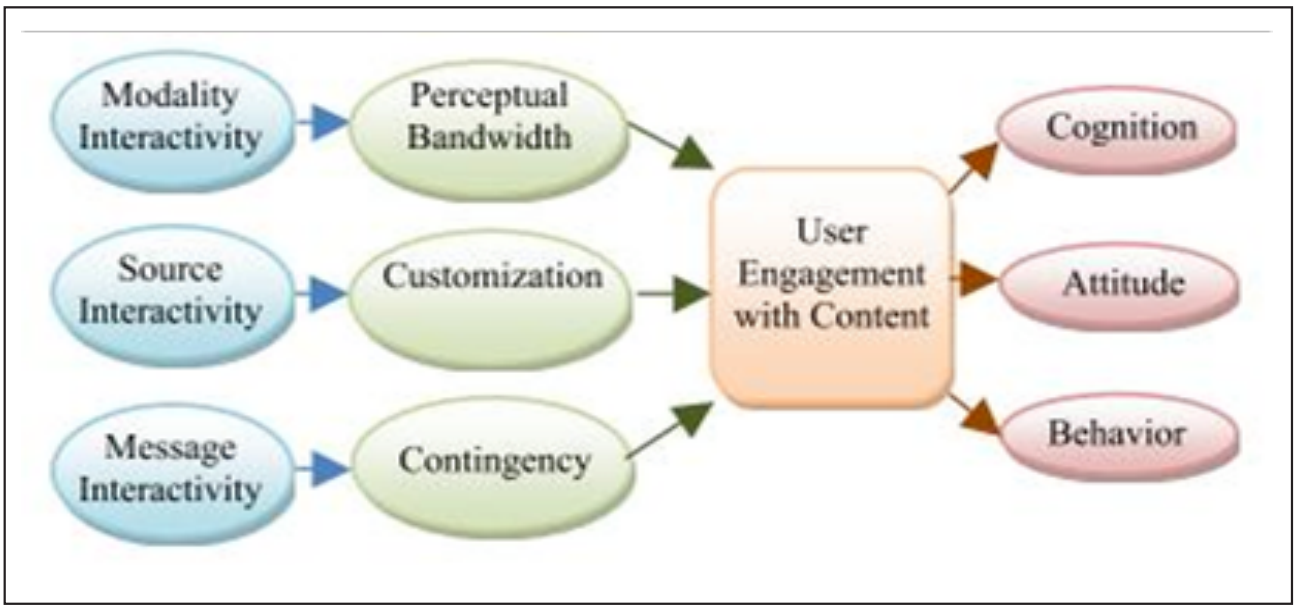


Figure 2 Model of interactivity effects *(adapted from Sundar, Xu, & Bellur, 2010)*

interactive digital media, specifically in video games, support a wide variety of modalities, including graphic images, texts, audio, video, motion, real-time feedback, and even haptic. Such interfaces that afford greater interactivity result in increased activation of mental representations and experience of mediated content. Hence, augmented virtuality exergames with a high degree of modality interactivity are likely to allow game users to highly interact with the virtual environment.

Role of Presence in Virtual Environments

Numerous studies in video game research have pointed to presence as a key factor that may influence the outcomes of video game exposure, including arousal, aggression, and enjoyment *(Bracken & Skalski, 2009; Eastin, 2006)*. Although presence has many broad dimensions and definitions *(Lee, 2004; Lombard & Ditton, 1997)*, we look at physical and social presence—two dimensions particularly relevant to video game studies. The sense of physical presence—the concept of *"being there" (in the video game's environment)*—refers to the basic states of consciousness in which users attribute the sources of their sensations to the virtual environment *(Biocca, 1997)*. Social presence refers to the degree to which users feel access to the intelligence, intentions, and sensory impressions of others *(Biocca, 1997)*.

Early research has shown that a connection between the self and virtual *(avatar)* identities within virtual environments can affect users' feelings of presence *(Benford, Bowers, Fahlén, Greenhalgh, & Snowdon, 1995)*. Due to recent technological advancements, some simulated environments, especially those found in video games, allow players to represent themselves by selecting or creating their own characters and avatar models. Through these processes, players can shape their mediated self-representations and engage more with virtual game environments, exercising more control over how they interact and play video games. Recent research by Bailey, Wise, and Bolls *(2009)* has identified the potential effects of avatar design on presence in online video games and suggested that avatar customization options can affect users' mental representations of their bodies as well as their behavior.

Regarding the study of virtual learning environments, recent questions have been raised about the effectiveness of active learning modalities *(e.g., self-driven and interactive learning activities)* and how they affect feelings of presence. Persky et al. *(2009)* have shown that the different configurations of the content and form for use in virtual environments can influence a sense of presence. In their study, however, the authors did not find a correlation between presence and either learning comprehension or information engagement in the active environment. Persky et al. *(2009)* pointed out the complexity of virtual environments *(VEs)* as a possible explanation for this unexpected result, suggesting that *"presence does not operate consistently among VEs but rather varies according to environment features" (p. 267)*. Nevertheless, as Dillon, Keogh, and Freeman *(2002)* indicated, it is expected that people might feel a high degree of presence because of real-time behavior feedback, as well as because of graphic visual cues in virtual environments.

Research Hypotheses and Experimental Design

Research Hypotheses

In this study, we operationalize different levels of modality interactivity by means of different combinations of behavioral feedback and physical cue. AV-based Xbox 360 Kinect Yoga is considered to possess a high level of modality interactivity as it provides game users with both visual real-time behavioral feedback and the physical cue of userself. Wii Fit Yoga, which provides the one-point motion based behavioral feedback with the 'beep' sound, is considered as the medium level of interactivity. Wii Yoga that presents the user's self-image on the screen is expected to contain a low level of modality interactivity. Lastly, Wii Yoga with no cues *(neither real-time behavioral feedback nor user's physical cue)* is used as the control condition corresponding to the absence of modality interactivity.

The AV technology allows users to be highly interactive with the interface in real-time. Therefore, AV-based Xbox 360 Kinect, which has high level of modality-interactivity-affordance, would greatly influence game users' perceived presence, enjoyment,

and immersion, and in turn, motivate users' physical exercise intentions. Therefore, we propose the following hypotheses.

H1: Participants who play Xbox 360 Kinect providing a high level of modality interactivity will experience higher perceived presence, immersion, and enjoyment than those who play Wii Fit with real-time behavioral feedback using one-point motion-detection feedback *(medium level*), Wii with the user's physical cue only using web-cam *(low level*), or Wii with no interactivity cues *(absence of both feedback and physical cue*).

H2: Participants who play Xbox 360 Kinect providing a high level of modality interactivity will show higher exergame playing intention than those who play Wii Fit with real-time behavioral feedback using one-point motion-detection feedback *(medium level*), Wii with the user's physical cue only using web-cam *(low level*), or Wii with no interactivity cues *(absence of both feedback and physical cue*).

H3: Participants who play Wii Fit with real-time behavioral feedback using one-point motion detecting technology *(medium level of modality interactivity*) will experience higher perceived presence, immersion, and enjoyment *(H3-1*), as well as will show higher exergame playing intention *(H3-2*) than those who play Wii with the user's physical cue only using web-cam *(low level of modality interactivity*).

According to regulatory focus theory *(Higgins, 1997, 1998)*, promotion-focused individuals are striving to achieve desirable outcomes *(gains or successes)*, while prevention-focused individuals are striving to avoid undesirable outcomes *(no losses or failures)*.
For promotion-focused individuals, the behavioral feedback and the physical cue would serve as a stimulus to encourage them to pursue the desired goal. Therefore, we formulate the following hypotheses:

H4: When playing Xbox 360 Kinect providing a high level of modality interactivity, participants who are promotion-focused will experience higher perceived presence, immersion, and enjoyment than those who are prevention-focused.

H5: When playing Xbox 360 Kinect providing a high level of modality interactivity, participants who are promotion-focused will show higher exergame playing intention than those who are prevention-focused.

Experimental Design

The present study employs a 4 *(the level of modality interactivity; high, medium, low, and none)* x 2 *(self-regulatory focus; promotion-focused and prevention-focused)* between-subject experimental design.

Methodology

In this study, we use three types of fitness exergame consoles *(Microsoft Xbox 360 Kinect, Nintendo Wii Fit, and Nintendo Wii)*, which have different levels of modality interactivity. To test the effects of different levels of modality-interactivity-affordance embedded in exergames, we use a between-subject experiment with exergames with the following four levels:

Level 1
(high): Microsoft Xbox 360 Kinect *(visualized real-time behavioral feedback with game user's whole body image*),

Level 2
(medium): Nintendo Wii Fit *(one-point motion-detection feedback based on game user's balance and weight; no user's body image presented*),

Level 3
(low): Nintendo Wii *(web-cam based self-body image; no motion-detection feedback provided*), and

Level 4
(no modality interactivity): Nintendo Wii with none of interactivity cues *(just following the video and virtual teacher's instructions*).

Independent Variables (IVs)

We consider the following two IVs: IV1 = training modality interactivity *(four levels as mentioned above)* and IV2 = self-regulatory focus [three levels; promotion-focused individuals, prevention-focused individuals, and neutral in their regulatory focus]. In particular, we assessed the types of participants' self-regulatory focus using

a standardized questionnaire developed by Lockwook, Jordan, and Kunda *(2002)*. In addition, we include gender, familiarity with exergames and video games, and familiarity with physical exercise as control variables in this study

Dependent Variables (DVs)

This study focuses on the following four DVs: DV1 = perceived presence, DV2 = immersion, DV3 = enjoyment, and DV4 = exergame playing intention.

Participants

During July through August 2011, a total number of 159 Sungkyunkwan University undergraduate students, graduate students, and staff members were recruited for this study.

Stimulus

Participants played a personal training 'Yoga' game which is available in the three exergame consoles used *(i.e., Xbox 360 Kinect, Wii Fit, and Wii, all of which has a similar interface)*. All participants were asked to follow the virtual training teacher's instruction, which appeared on the screen. Participants were randomly selected to participate in one of the following four experimental conditions. In the condition of high-level modality interactivity with visualized real-time behavioral feedback with the user's physical cue *(Level 1)*, participants play Xbox 360 Kinect, follow virtual teacher's instructions, and receive real-time feedback from the teacher when they move their physical body. In the condition of medium-level modality interactivity *(Level 2)*, participants play Wii Fit, which provides one-point behavioral feedback based on their motion. In the conditions of low-level modality interactivity *(Level 3)* and the absence of modality interactivity *(Level 4)*, participants are asked to play Wii, which is manipulated by the condition.

Procedure

Pre-measures: The experiments were performed in a specially designed lab. Upon entering the lab, participants were asked to read and sign an informed consent form. Participants were also asked to complete a self-regulatory focus measure to decide if they are promotion-focused or prevention-focused.

Exposure: Participants were randomly selected to participate in one of the aforementioned four experimental levels. After tutorials given by the experimenter, participants played Xbox 360 Kinect or Wii Fit or Wii for about 20 minutes. The experimenter was outside the lab and occasionally checked on the participant during exergame play.

Post-measures: Participants were asked to complete a post-questionnaire including perceived presence, immersion, enjoyment, and exergame playing intention. At the end of the session, a survey was administered to collect the basic information about the participant, including gender, age, exergame playing experience, and physical exercise experience. The complete experiment took approximately 50 minutes to 1 hour.

Level of modality Interactivity	Presence	Immersion	Enjoyment
Level 1 (high)	**3.60** (.54)	**3.69** (.61)	**3.64** (.50)
Level 2 (medium)	**2.93** (.73)	**3.58** (.61)	**3.32** (.54)
Level 3 (low)	**2.42** (.77)	**3.23** (.64)	**3.14** (.53)
Level 4 (none)	**2.21** (.74)	**3.44** (.79)	**3.13** (.65)

Table 1

Means (and Standard Deviation) of Presence, Immersion, and Enjoyment Measures for Participants Using Different Level of Modality Interactivity [Scale: 1 (lowest); 7 (highest)].

Level of Modality Interactivity	Exergame playing intention
Level 1 (high)	**3.85** (.76)
Level 2 (medium)	**3.36** (1.10)
Level 3 (low)	**3.16** (.90)
Level 4 (none)	**3.14** (.98)

Table 2

Means (and Standard Deviation) of Exergame Playing Intention for Participants Using Different Level of Modality Interactivity [Scale: 1 (lowest); 7 (highest)].

Results and Discussion

Of the total 159 participants in this study, 54.7% were male and 45.3% were female. The mean age was 24.2 years with SD = 3.4 *(range 18–42)*. 92.5% were undergraduate students, 5.0% were graduate students, and 2.5% were staff members. The average exergame familiarity and exercise familiarity of the participants were 3.57 *(SD=2.11; range 0–9)* and 3.75 *(SD=1.72; range 1–7)*, respectively. The participants were approximately equally distributed across the four levels: Level 1 *(24.5%)*, Level 2 *(24.5%)*, Level 3 *(25.8%)*, and Level 4 *(25.2%)*.

A series of one-way ANOVAs were performed to examine the effect of level of modality interactivity on psychological reactions to the exergame playing experience. The results indicated that there was a substantial main effect of modality level on both presence $(F(3,155) = 30.04, p < .001)$ and enjoyment $(F(3,155) = 7.23, p < .001)$ and a moderate effect on immersion $(F(3,155) = 3.49, p = .017)$. As shown in Table 1, participants who used the high modality interactivity exergame reported the highest levels of all three measures. These results provided support for both H1 and H3-1, which posited that participants who play exergame consoles with a higher level of modality interactivity would show higher perceived presence, immersion, and enjoyment than those who play exergame consoles with a lower level of modality interactivity.

Next, the effect of modality interactivity on the participants' exergame playing intention was examined. As with the other ratings,

Level of Modality Interactivity	Type of self-regulatory focus	Presence	Immersion	Enjoyment
Level 1 (high)	Promotion-focused Neutral Prevention-focused	**3.70** (.58) **3.77** (.55) **3.36** (.71)	**3.91** (.60) **4.05** (.52) **3.14** (.60)	**3.97** (.89) **3.90** (.81) **3.81** (.77)
Level 2 (medium)	Promotion-focused Neutral Prevention-focused	**2.62** (.83) **3.41** (.60) **2.84** (.66)	**3.25** (.55) **3.81**(.67) **3.80** (.30)	**3.00** (.1.13) **3.81** (.80) **3.67** (1.13)
Level 3 (low)	Promotion-focused Neutral Prevention-focused	**2.44** (.89) **1.96** (.69) **2.74** (.92)	**3.15** (.72) **3.37** (.45) **3.40** (.72)	**3.21** (.78) **2.79** (.1.01) **3.38** (1.03)
Level 4 (none)	Promotion-focused Neutral Prevention-focused	**2.15** (.70) **1.96** (.22) **2.27** (.85)	**3.24** (1.04) **3.40** (.28) **3.47** (.77)	**3.18** (1.12) **3.00** (.71) **2.97** (1.24)

Table 3 Means *(and Standard Deviation)* of Presence, Immersion, and Enjoyment Measures for Participants with Different Type of Self-regulatory Focus Who Played Exergame Consoles with Different Level of Modality Interactivity [Scale: 1 *(lowest)*; 7 *(highest)*].

Level of Modality Interactivity	Type of self-regulatory focus	Enjoyment
Level 1 (high)	Promotion-focused Neutral Prevention-focused	**3.97** (.89) **3.90** (.81) **3.81** (.77)
Level 2 (medium)	Promotion-focused Neutral Prevention-focused	**3.00** (.1.13) **3.81** (.80) **3.67** (1.13)
Level 3 (low)	Promotion-focused Neutral Prevention-focused	**3.21** (.78) **2.79** (.1.01) **3.38** (1.03)
Level 4 (none)	Promotion-focused Neutral Prevention-focused	**3.18** (1.12) **3.00** (.71) **2.97** (1.24)

Table 4

Means (and Standard Deviation) of Exergame Playing Intention for Participants with Different Type of Self-regulatory Focus Who Played Exergame Consoles with Different Level of Modality Interactivity [Scale: 1 (lowest); 7 (highest)].

there was a significant effect of modality interactivity level on exergame playing intention, $F(3,155) = 4.82$, $p = .003$. As shown in Table 2, participants using the high modality interactivity exergame reported the highest levels of intention *(supporting H2)*. H3-2 predicted that participants who play exergame consoles with the medium level of modality interactivity would experience higher intention than those who play exergame consoles with the low level of modality interactivity. As shown in Table 2, H3-2 also received support.

H4 and H5 predicted that participants who are promotion-focused would experience higher perceived presence, immersion, enjoyment, and exergame playing intention than those who are prevention-focused. The data in Tables 3 and 4 indicated that the differences between the types of participants' self-regulatory focus were not obvious. This was further confirmed by the two-way ANOVA results, where there was no statistically significant effect of self-regulatory focus on the participants' presence $(F(6,105) = 2.14$, $p = ns)$, immersion $(F(6,105) = 2.03$, $p = ns)$, enjoyment $(F(6,105) = .76$, $p = ns)$, and exergame playing intention $(F(6,105) = 2.13$, $p = ns)$. Therefore, both H4 and H5 were not supported.

Summary

The focus of the present study was to understand the interaction of users with virtual game environments and how this relationship affects their behaviors in real life. We investigated how different types of self-regulatory focus and different levels of modality interactivity in the context of exergames affect game users' perceived presence, immersion, enjoyment, and exergame playing intention. The results of our study did not suggest that the role of individualistic regulatory focus is necessarily significant. However, our results clearly revealed that participants who played exergames with a higher level of modality interactivity showed higher level of presence, immersion, enjoyment, and exergame playing intention than those who played exergames with a lower level of modality interactivity. These findings might indicate that the use of virtual game environment with augmented virtuality concept could promote a person's intentions and subsequent behavioral changes in real life.

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Virtual Worlds as a Platform for 3D Application Development

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Abstract

Multi User Virtual Worlds are a new type of Internet application. They offer the potential of bringing the engagement and realism of 3D games into the domain of computer supported education. The genre is currently dominated by Second Life (SL), a commercial virtual world, and OpenSim, an open source toolkit for building virtual worlds. The programmability of SL is limited to simple scripts. OpenSim contains support for additional programming modes. This paper discusses a novel programming framework used to create 'Routing Island', a virtual world space which allows students to interact with 3D simulations of Internet routing protocols. To achieve this it was necessary to create a programming framework which allows code to be written and compiled externally, using an arbitrary IDE, and for the executable code to be imported into OpenSim while the server is live. This framework has been used to develop a graph theory based visualisation tool that is fully situated within a virtual world. This visualiser can be used to create interactive simulations of Link State and Distance Vector routing algorithms. The educational resources created within this novel programming framework highlights just how powerful virtual worlds can be as a development platform and how this power can be harnessed for education.

Introduction

Virtual Worlds *(VWs)* are a developing Internet application. Being relatively new their limits have not yet been reached and their potential is only starting to be explored. VWs have shown promise as a platform for educational environments and resources. Some projects are fairly basic, looking at how the new platform's shared spaces can be used for remote interaction e.g. tutorial groups, seminars etc. Others focus more on information presentation e.g. posters, slides etc. Relatively few projects emphasise interactive 3D simulation and the use of a game based approach.

One thing all VW education projects tend to have in common is how they use scripted content. This is generally limited by the VW itself, due to the scripting paradigm provided by Second Life *(SL) (Linden Labs, 2010)*, the dominant commercial VW. In SL scripting is deliberately simplified and limited for a number of reasons. This paradigm fits well with *"show and tell"* style applications but more complex programs are hard to implement effectively. This project aims to raise the bar on what can be achieved in terms of developing an educational project involving software engineering and high-level programming.

The topic being taught in this case study is Internet routing algorithms. The routing algorithms which underpin the Internet are crucial to its success. Without the ability to route packets confidently from one side of the world to the other the Internet would never have reached the level of ubiquity it has achieved in modern life. As such learning about these core algorithms is something that is an integral part of any computer networking course and teaching them well is a goal with significant value. This can be difficult because routing algorithms are by nature dynamic, abstract and invisible. The way they react to changes in the network can be hard to visualise in static, paper based diagrams. The fact they are distributed means that making the connection between lines of pseudocode in a text book and the algorithms which are running the Internet can be hard. Helping students to visualise how the abstract algorithms they have been taught relate to the dynamic, global, Internet is a challenge. Attempting to situate the algorithms in a context where they can be related back to real life can help students bridge this gap.

Students intuitively understand 3D games and can relate to the metaphors that games provide with regards to interaction and avatars. They also benefit from a feeling of presence and community. In an online, MMORPG style game students can interact to tackle a problem or investigate a simulation. Implementing a routing demonstration simulation in a game like environment could help students to gain a more direct understanding of how routing algorithms function. The problem is that developing a game from scratch is a major project. Much of the code that would have to be developed would have little to do with the routing project. Even once completed the user would be required to load custom software which had a very narrow focus. Games are also rarely focused on delivering user-created multimedia style content making it hard to provide supporting content within the environment. VWs provide a form of middleware where these problems can be avoided.

The benefit of VWs is that their primary purposes are socialisation and content creation. They are designed for adding, scripting and sharing content. They are also standardised to some extent. For example VW browsers allow you to connect to a multitude of different VWs. The Second Life viewer allows you to connect to SL as well as any one of the many OpenSim grids. Working in VW gives you all the benefits of a game like environment - presence, the 3D metaphor, immersion - combined with a platform that is designed to be modifiable.

While VWs represent an excellent opportunity for teaching about Internet routing in a more dynamic, involved manner, there are still challenges to be overcome. Traditional Virtual World models are fairly limited in the power users are given to program the environment. SL, currently the largest and most widely recognised virtual world, imposes very strict limits on what users can script and create. Developing a complex application such as an interactive routing simulation with conventional VW tools would be exceptionally hard. As such a problem to be solved is how to adapt VWs to be a better platform for developing more advanced content without having to modify the VW itself. The work reported in this paper addresses this problem. The solution is a system known as External Mini Region Modules *(MRM)*. External MRMs are used to develop a complex, interactive and stimulating application for the purpose of teaching Internet routing algorithms. This application and its surrounding environment are known as Routing Island.

This paper starts by discussing some related work. This mainly consists of looking at other attempts to teach routing algorithms and other projects which use Virtual Worlds for education. Once the context is established the Routing Island project is introduced from a user perspective and the challenges facing its development outlined. After that the External MRM programming framework is presented. The paper then describes the implementation of Routing Island using the framework. The paper continues by discussing evaluation carried out to date and planned future work, before concluding.

Related Work

This section looks at 2D applications that support learning about Internet routing, projects that use VWs for education and projects with some relation to the External MRM system which will be described later in this paper

Teaching Internet routing

There are many resources which support learning about Internet Routing. Typically the format is a website with text and diagrams explaining the algorithms. Sometimes the resources are interactive e.g. applets or flash diagrams. An example website is St Andrew's Open Shortest Path *(OSPF)* routing information site by Link et al. 2009. An example of an applet designed to teach the details one of the algorithms behind OSPF routing is Carla Laffra's Dijkstra's Shortest Path algorithm applet *(Laffra, 2011)*.

As well as teaching Internet Routing there are also systems whose purpose is to simulate networks and how they run. The most well known of these is NS-2 *(Open Source, 2010)*. This is complex software designed to simulate the full network stack and investigate how algorithms perform. It is not focused on visualisation, more on simulation, and would be considerably too complex for most educational purposes

Education in virtual worlds

So far most of the educational applications in VWs have followed three patterns. The majority, like Andreas et al. – 2010, leverage the multimedia properties of VWs to provide an engaging environment to present content in. They are essentially *"show and tell"* displays. The second pattern is to provide a simulation such as Chodos et al. 2010 and Stricker and Clemons 2009. Here an environment is provided where users can play out some analogue of a real life scenario, often for training purposes. The last pattern is to put the presentation of the material in a virtual world but link it up to an external simulator of some kind. This is done in Sturgeon et al. 2009 and Prada et al. 2010. In this pattern any complex logic is performed externally on a separate server that can only interact with the virtual world by responding to requests. They are generally limited in their interaction.

Extending virtual world capabilities

Currently there is no mainstream mechanism defined for tying external scripts directly into a VW. One group who have looked at such a mechanism are Brota et. Al in 2009. They want to attach code to in-world objects client so as to change how an object behaves depending on the client accessing it. Stellar Sim *(Henckel and Lopes, 2010)* is another system which uses a plug in mechanism to perform script style actions. This visualises the orbits and behaviors of planetary objects in outer space in OpenSim using a Region Module based plug in mechanism.

Routing Island

Routing Island, shown in figure 1, is a virtual space designed to support learning about Internet routing technologies. It provides an interactive, intuitive visualisation and simulation tool which allows students to literally 'play' with the algorithms in a sandbox environment. Users are able to create a topology, send packets across the topology and see how the routes for the topology they created were calculated. They can then alter the topology and watch as the algorithms adapt the route. This visualisation tool is supported within an interactive, multimedia, educational environment containing supporting material to help the user gain a deeper understanding of the topic.

Context

One of the reasons why Virtual Worlds have potential for learning support is their ability to integrate multimedia. They allow videos to be streamed, lectures to be presented, slideshows to be displayed and external web pages to be shown or linked to all in one, cohesive, 3D, virtual space. Routing Island

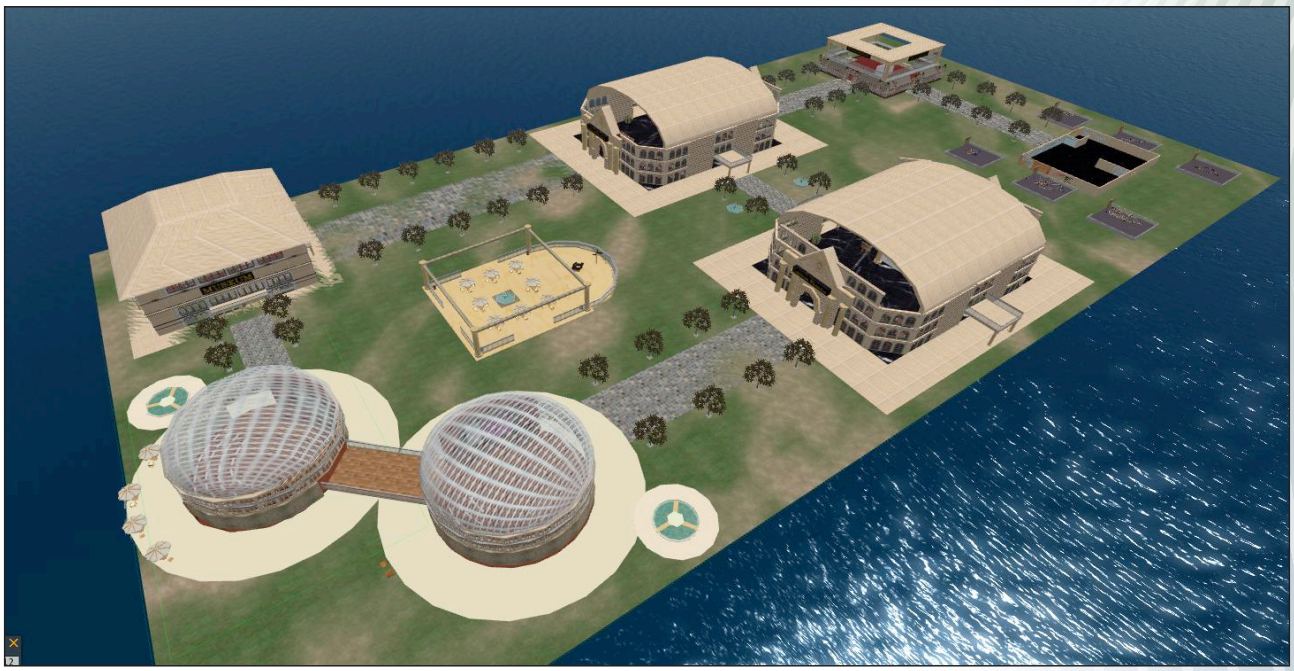


Figure 1 A view of Routing Island from above

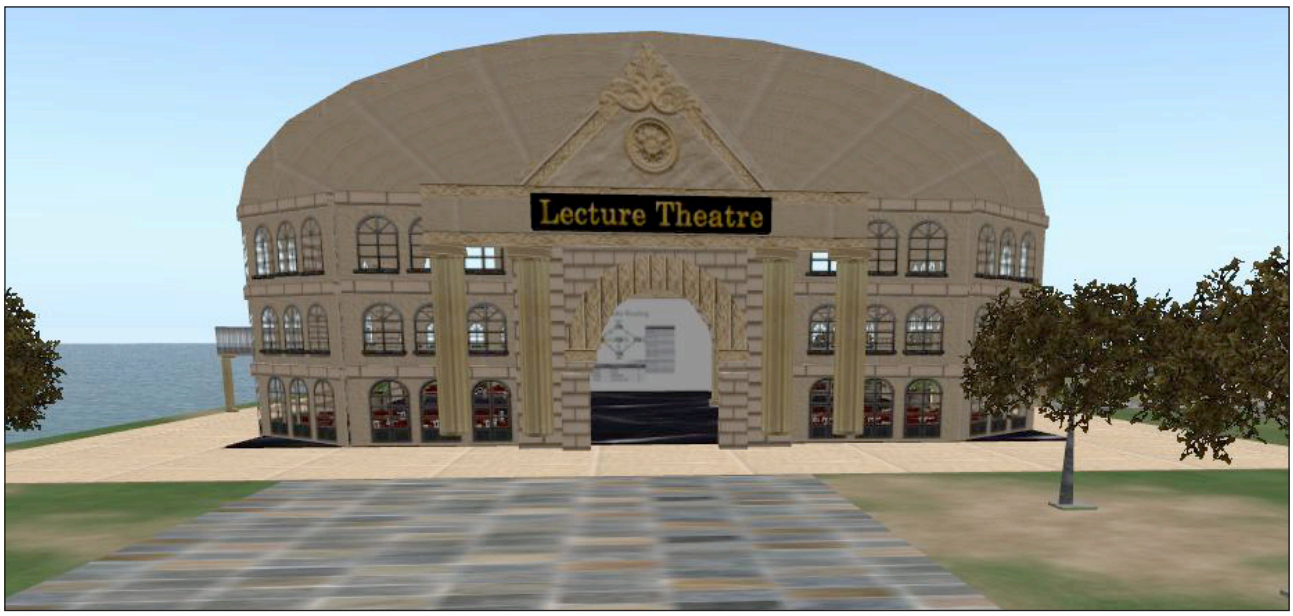


Figure 2 The lecture theatre

takes full advantage of this. It provide a range of different material supporting students learning about Internet Routing.

The way the supporting media is presented is in the form of an 'Island'. The Island has a series of facilities designed to help the user understand the topic. The form of these facilities each represent what kind of information they are used to present. There is a cinema, figure 3, used to stream pre-recorded or live videos of lectures on Internet routing. Live, in-world, lectures can be delivered in the lecture theatre, figure 2. The museum, figure 4, houses historical information about the development of Internet routing technologies. The document repository, figure 7, serves as a hub linking out to external, web based, resources or displaying the resources in-world

The supporting material gives a static foundation for learners to start understanding the algorithms. The system itself then provides a dynamic way of interacting with the algorithms to allow students to turn the theory, presented through the multimedia displays, into practice, interacting with the algorithms as they are implemented in-world.



Figure 3 The cinema



Figure 4 The Museum

Routing Island software

The dynamic visualisation tool is the core of the Routing Island project. It is designed as a simple way for users to gain an understanding of how an algorithm is functioning. Users see routers, end points, links and packets as *"physical"* objects in-world. Users can create these primitives and use them to build up a topology. Figure 5 shows a topology with packets *(glowing in the figure)* moving along links between routers and end points. Once they have a topology they can then trigger packets to be routed across it or for an algorithm to be visualised. When the user changes the topology the effect the changes have on the forwarding tables are visualised as they are made.

All interactions the user has are context sensitive. In order to create a new node the user touches *(clicks)* on the ground and a node appears at that point. Figure 6 shows the sequences of events and state changes that allows users to perform two basic actions: linking two nodes and visualising an algorithm running between two nodes. The second action represents the most complex series of inputs the user will ever have to make to control the system. Figure 8 shows a

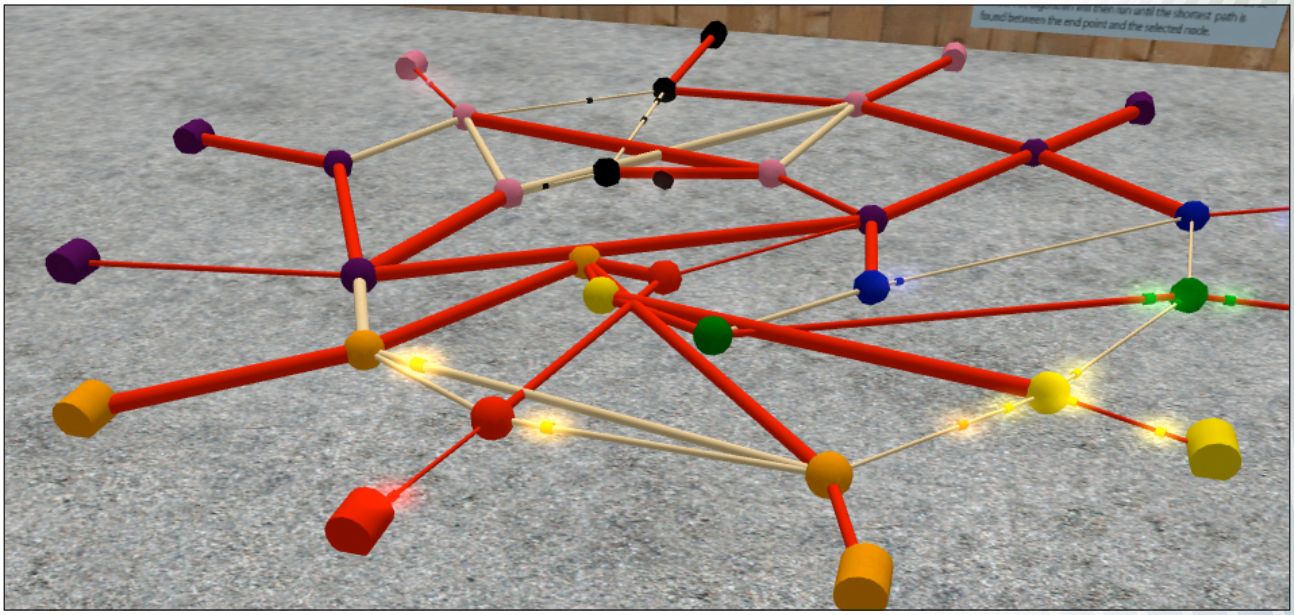


Figure 5 Distance Vector running with routes to the central red node highlighted

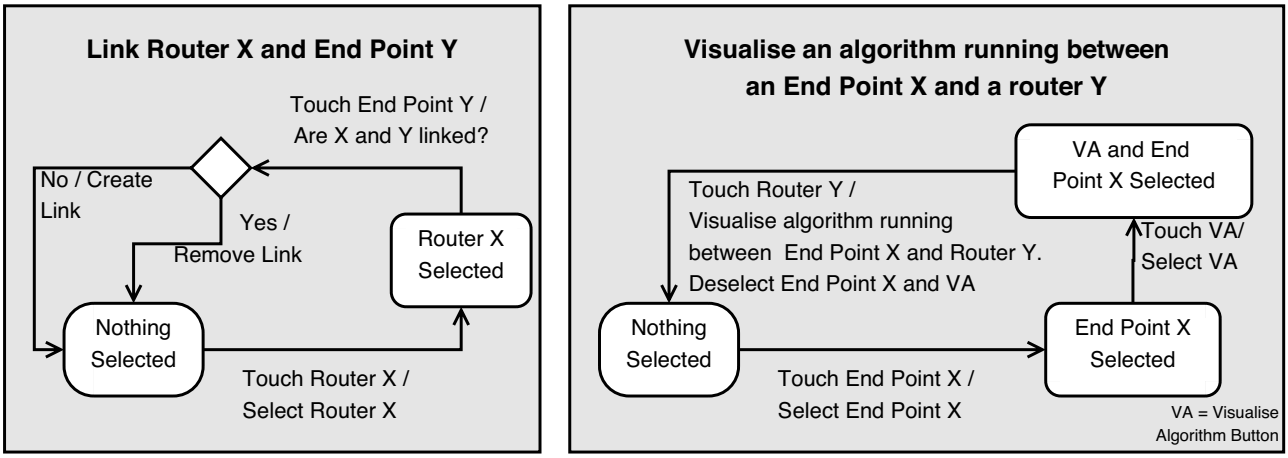


Figure 6 Two operations and the signal sequences that will trigger them.

full state diagram for all the actions the user can perform by touching the entities which make up the topology. The actions described in detail in Figure 6 are highlighted as bold arrows in Figure 8.

Another way to change a link's weight is to physically move one of the nodes attached to it, causing it to reposition. By default the weight of a link is defined as the scalar distance between the two nodes. This means that if a user moves a node further away from the rest of the nodes in the topology, the links connected to that node will get longer and their weights will increase. The user can then watch these changes being propagated through the network and the routing changing accordingly.

The system currently visualises two Routing algorithms, Distance Vector as used in RIP and Link State as used in OSPF. Distance Vector algorithms are dynamic routing algorithms. They are visualised by showing all the packets which are sent out as part of the algorithm and highlighting specific shortest routes.

The other algorithm which the system visualises is the Link State routing algorithm. Link state is a static algorithm. Every node requires a complete graph representing the network topology in order to calculate the correct routes. The flood packets used to build up these graphs are visualised. Once a node has a graph it runs Dijkstra's Shortest Path algorithm to calculate routes to each end point and so create a forwarding table. The system visualises Dijkstra's Shortest Path algorithm

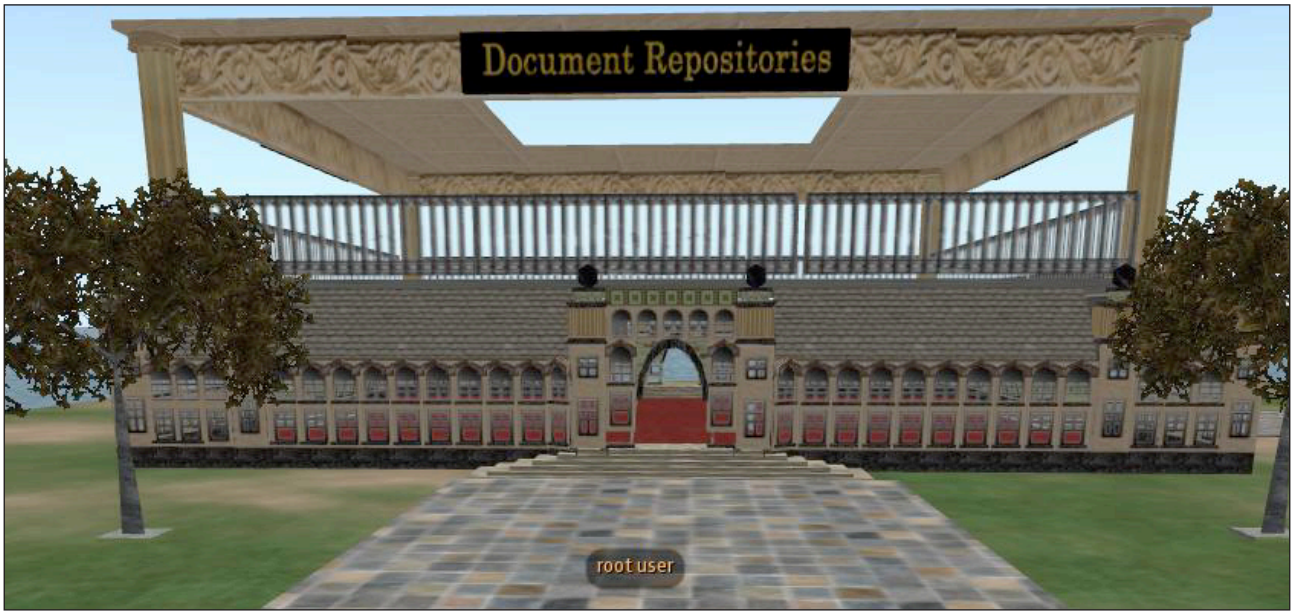


Figure 7 The Document repository

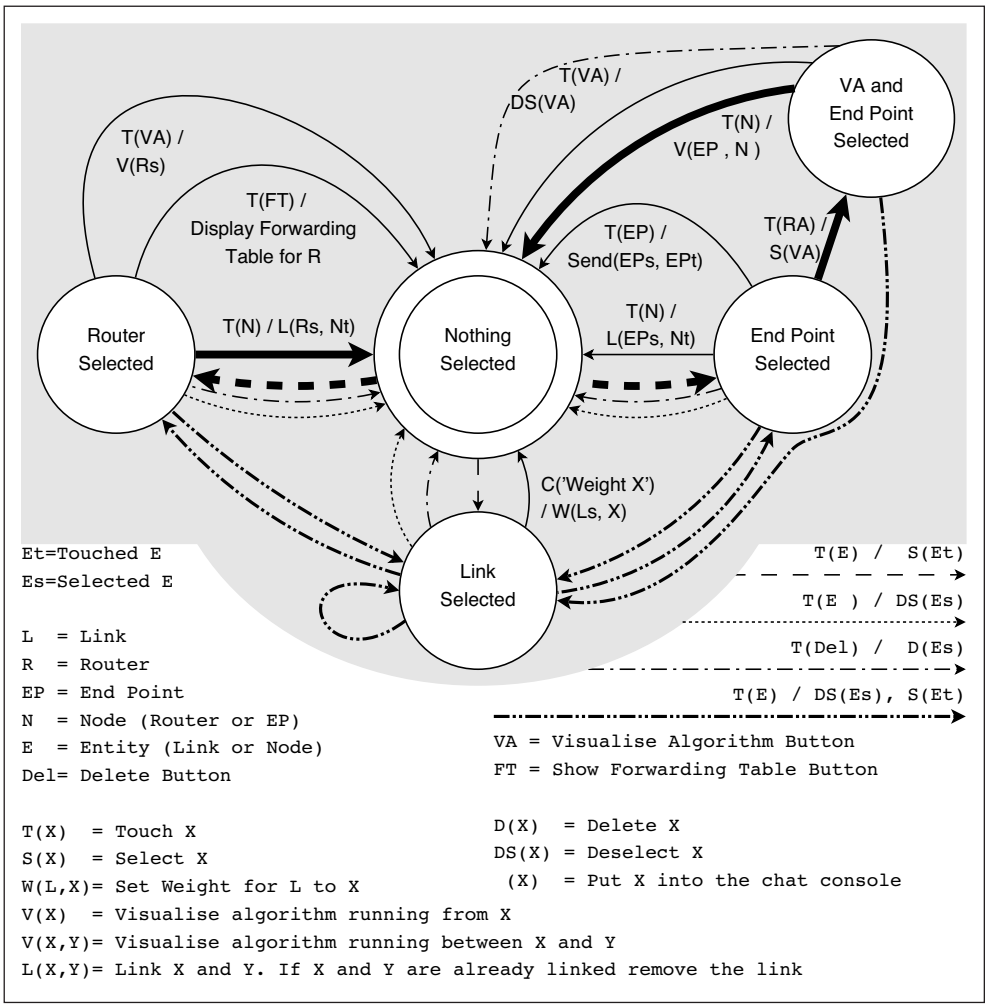


Figure 8

State transition diagram for the various input states and actions

running by changing what nodes and links are highlighted as the algorithm iterates across the topology.

The two algorithms are very different and as such are visualised quite differently. As well as being flexible in terms of how it visualises algorithms the system is also flexible in how it is instantiated and controlled.

Routing Island configuration

The way the system is designed is that it is modular and can be instantiated in a number of different configurations. The three basic ways the system can be configured to load are with a static topology, playing a pre-recorded set of events or as a sandbox.

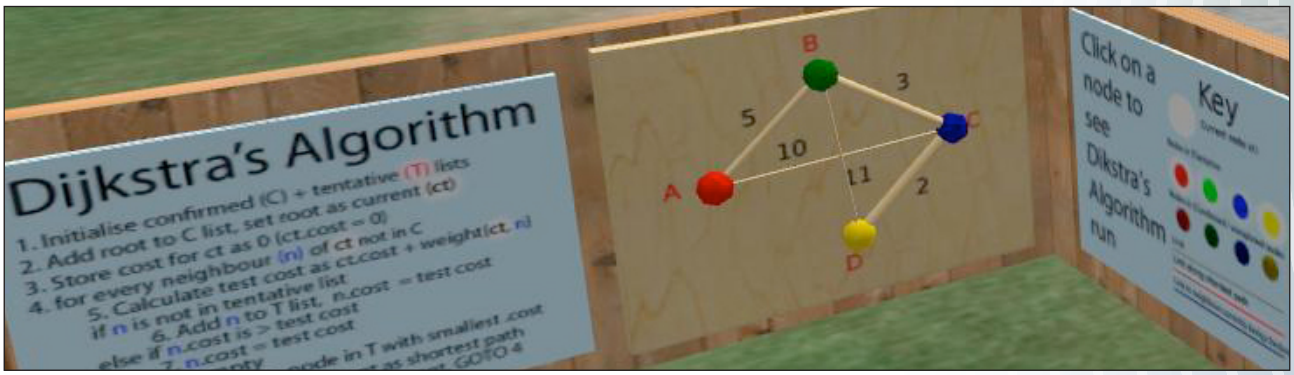


Figure 9 A static topology demonstrating Dijkstra's Algorithm

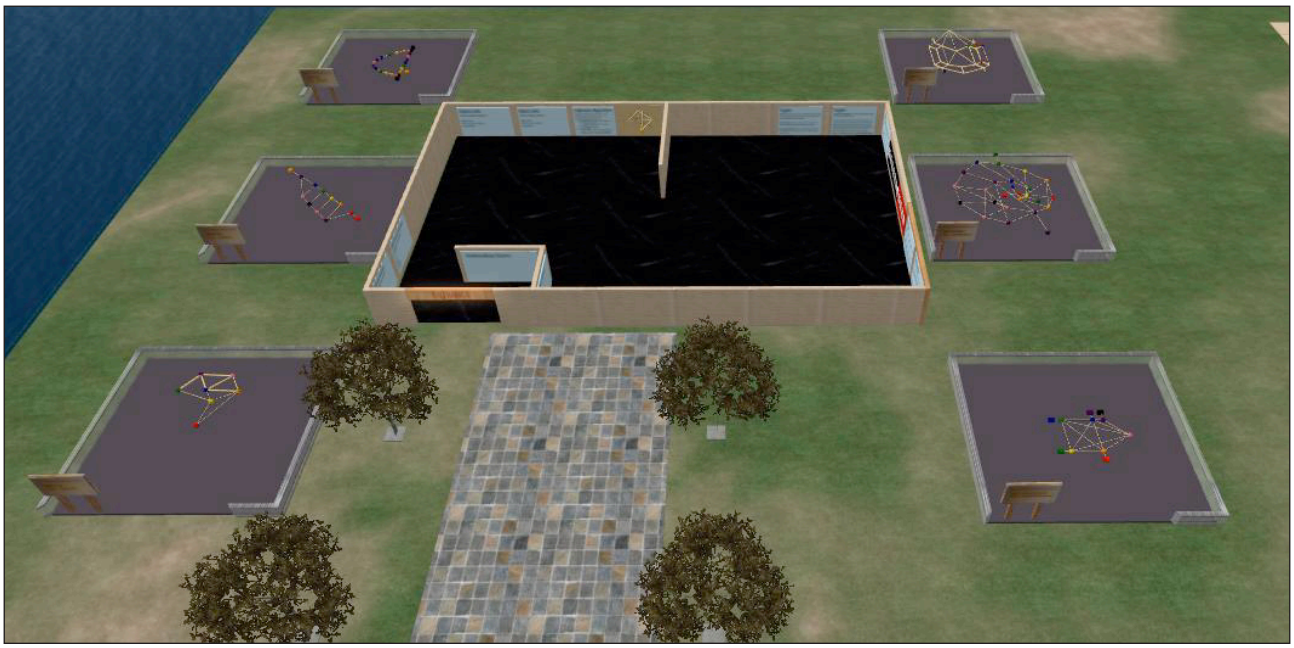


Figure 10 The sandbox

Static topologies and event sequences function as interactive diagrams. They represent simple scenarios which demonstrate various aspects of the algorithm running, often edge cases or counter intuitive examples. These static configurations can have various degrees of interactivity. Figure 9 shows a static topology.

The sandbox mode is the interactive system described above and is what allows the user to 'play' with live algorithms. In sandbox mode users can place nodes and link them up to create their own topology.

Routing Island as it stands only uses the static scenarios as interactive diagrams and the sandbox for allowing students to experiment with an algorithm. The interactive area of the Island is shown in Figure 10. The central area is the sandbox, the outer satellite areas are static topologies. In future more ambitious uses could be envisaged. To try and help users understand the link between the abstract algorithms and the real world models of real world locations could be created in the VW. An example of this could be a model of a university's campus. Nodes could then be placed down at places corresponding to where the routers are placed in the real life equivalent and links put in representing the real links between those routers. The student could then watch as a packet was routed from a node representing their laptop in their dorm room through to the teaching servers in their department, or off to a switch connected to the wider internet. Students could then investigate what might happen if power was lost in a specific building or if a certain link was to fail. This all helps to try and link abstract knowledge of an algorithm to a dynamic understanding of how that algorithm is functioning in the real world.

Programming virtual worlds

The benefits of situating Routing Island within a VW are great but the limits imposed by the traditional VW programming models would have made developing it impossible. This section outlines these constraints and the solution which was developed, known as External MRMs. External MRMs turn VWs into a far more attractive platform for developing powerful, interactive, 3D online applications.

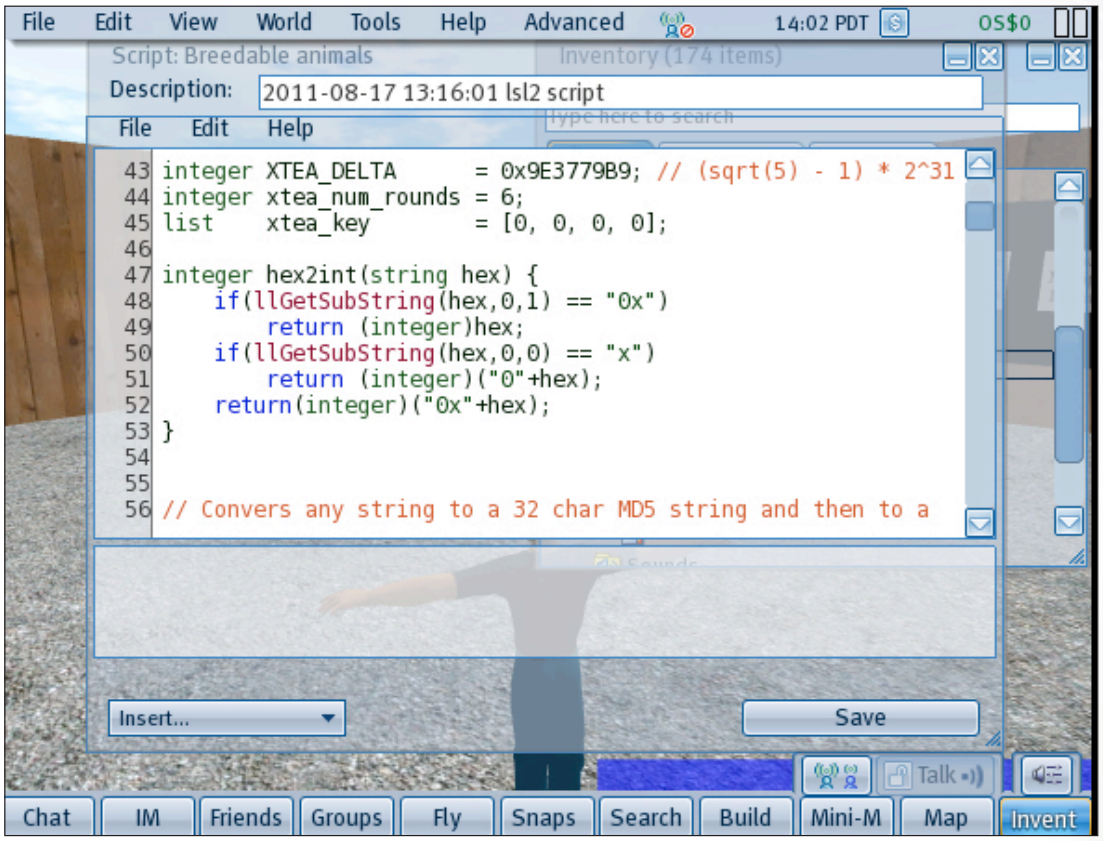


Figure 11

An LSL script being edited in-world

Virtual world programming paradigms

The largest VW currently available is Second Life *(SL)*. The constraints to working in SL are outlined in Allison et al. 2010.

The biggest alternative to SL currently is OpenSim *(OpenSim, 2010)*. OpenSim is an open source project which took the open source SL client, looked at the protocols it was using to communicate with the SL server and reverse engineered a version of the server. Users can freely download and install. Users then connect to the OpenSim based virtual world using their preferred SL client. OpenSim servers can be configured however an administrator wishes. They can be opened up so that users can write powerful, if potentially damaging, scripts.

[1] A system exists for loading MRMs externally but has several major flaws and development appears to have stopped. http://maimedleech.wordpress.com/2009/05/12/opensim-programmability/.

The spectrum of standard ways one can interact with OpenSim are as follows:

- Primitive Manipulation. Using an in-world GUI the user can create, modify, adjust and relocate primitive objects.
- LSL. LSL is a user-friendly state-based scripting language designed for SL. It provides a simple API for interacting with its host object and some more advanced functions such as making HTTP requests to external servers. In OpenSim LSL-style scripts can be written either in LSL or in C#.
- MRMs. MRMs are a C# API allowing access to LSL-like, the OpenSim scenegraph and a mechanism for writing code against the API in-world.
- Region Modules. These are the mechanism defined for extending OpenSim's core functionality. They are written externally as C# libraries and are loaded into memory with OpenSim.
- Modifying OpenSim. Because OpenSim is open source, programmers can modify their servers to add or alter functionality. This mechanism is not recommended, as it will quickly result in an OpenSim installation which has branched off from the main code base and is liable to break core OpenSim functionality.

Developing Routing Island in a virtual world

Developing Routing Island using LSL would be impossible. MRMs have the necessary power for developing Routing Island but lack the development environment. Using Region Modules to implement Routing Island would be unnecessarily complex. They provide no conveniently simplified mechanisms for manipulating objects in a script-like manner and require server restarts with every recompile. These reasons meant that developing Routing Island highlighted a gap in the spectrum of programming mechanisms. Users wishing to write script-style code from an external IDE and then plug it into the server live cannot do so. To solve the challenge of the gap in the spectrum the External MRM system was developed.

Exposing the power of virtual worlds

External MRMs are a new way of scripting VWs that allow the benefits of scripting *(no server restarts, and a simple API)* to be combined with the benefits of extending functionality through external libraries. The benefits of working with external libraries are that code can be developed at a much higher level of abstraction and can take full advantage of advanced IDEs and the ability to reference support libraries. External MRMs work by externalising the MRM API away from OpenSim. The core of the MRM API exposes two interfaces. The first is a mechanism for interacting with the OpenSim scenegraph, this is called IWorld. The second defines an in-world primitive, this is the IObject interface. An IWorld instance lets programmers obtain an IObject instance for any primitive in-world and to create new primitives. The MRM API is what allows for script-like behaviour to be coded simply without any advanced understanding of the OpenSim internals being necessary.

Traditionally MRMs are written in-world and compiled dynamically by code plugged into OpenSim as a region module. External MRMs provide a new interface for bootstrapping an MRM. MRMs are written as external libraries and the location of the library referenced from a script in-world. The MRM in the library is then loaded into a separate Application Domain. An Application Domain is a lightweight process. Application Domains have their own address space, security restrictions and application context. This means different Application Domains resolve assemblies separately and keep them separate in memory. Because of this if a library is recompiled a new Application Domain will load the new version. This allows a live plug in mechanism to be implemented. External MRMs allow users to type a command in-world to unload the application domain with the MRM loaded and reload it with recompiled changes now present.

How external MRMs work is that the user writes their code as a series of dependant libraries, one of which implements the ISystem interface defined in the External MRM API. The ISystem interface is shown in Figure 12. They then go in-world and write a script which points to a config file containing the location of the ISystem implementation. This is then loaded up as an MRM in a new Application Domain. If the user wishes to change the code all they have to do is make the changes, recompile externally then restart the External MRM live in-world.

ISystem
+Chat(sender:IEntity,text:String): void +Clear(senderID:UUID,sender:String): void +Start(host:IHost,world:IWorld,listenerAdder:method, shutdown:method): void +Stop(): void +Touched(touchee:UUID,args:TouchEventArgs): void +UpdateWorld(world:IWorld): void

Figure 12 The ISystem interface used to bootstrap an External MRM

Routing Island – design and implementation

This section will show how the Routing Island software is designed and how it uses the External MRM mechanism to plug itself into OpenSim.

Design

The design of the system is based on the Model, View, Controller pattern. Each Module *(model, view, control)* is defined as an interface in a framework library. Each of these interfaces is then implemented in its own library. The entities that make up the system are modelled by another set of interfaces

again defined in the framework library. These entity interfaces are defined in figure 13. Instances of these interfaces are passed between the modules to share state. Each module then extends the entity interfaces to add the extra functionality it needs.

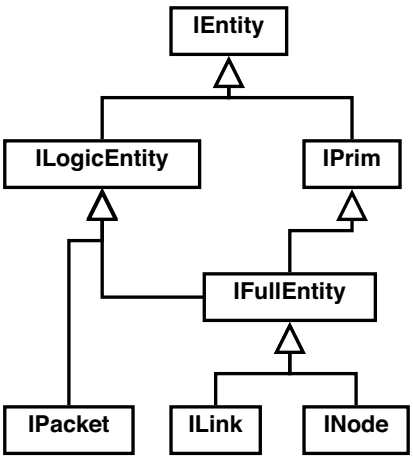


Figure 13 The interfaces which define the basic entities used to model the network topologies.

The various modules are designed to be instantiated in a loosely coupled manner. Because modules only interact through interfaces defined in a separate library different implementations of these interfaces can be swapped out without altering the other modules. The class which instantiates the modules reads in the locations of the assemblies which implement the interfaces from a config file at run time. This loose coupling means different configurations of the system can be instantiated just by altering the configuration file. All the libraries which make up the system and their dependency relationships are modelled in figure 14.

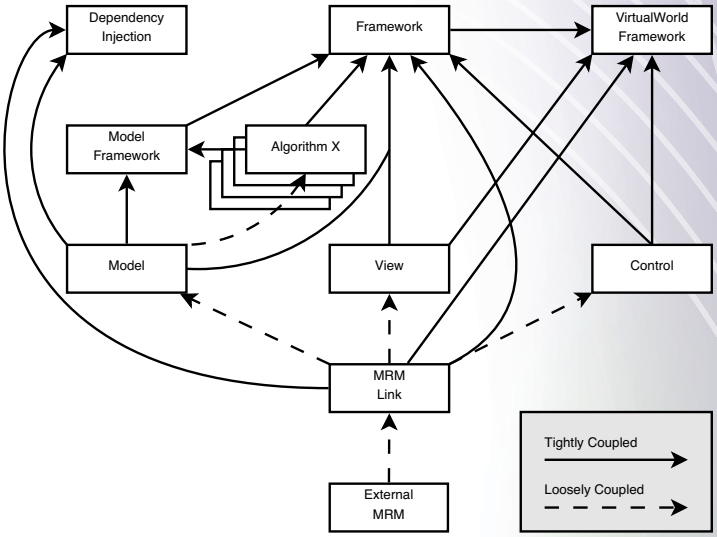


Fig. 14 The various libraries which make up the system and their dependencies

OpenSim integration

Routing Island uses the External MRM system previously outlined to integrate itself into OpenSim. Its integration is in three parts. Firstly it has to be able to start itself up. This is achieved by implementing the ISystem interface from figure 12. The second part is how the system affects the VW. To do this the implementation of ISystem wraps IObject instances, provided from the underlying MRM, in the IPrim interface defined in the VW Framework library. IPrim provides properties that allow physical features of the primitives, such as position or shape, to be altered. The third part is how the system receives user input. IPrim wraps events exposed by IObject which allow listeners to be registered for touch, delete or chat events triggered in-world

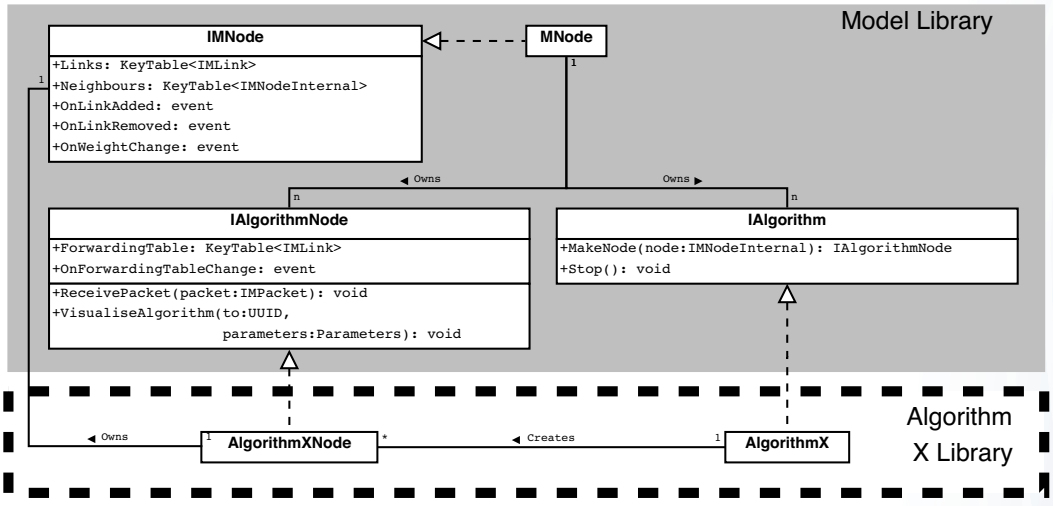


Figure 15

The relationships between the interfaces and classes which define the algorithm plug in mechanism

Extensibility

An important part of the system is its extensibility. Because of the loosely coupled nature of the system any of the modules can be re-implemented or extended to drastically alter the behaviour. While this is an option for extensibility there are two mechanisms which are designed specifically to allow simple extensions to be implemented.

The first is the algorithm mechanism. The system as a whole is designed to be independent of what algorithm is running. The ability to create or alter a topology is completely separate from how the algorithms themselves are implemented. As shown in figure 14 the libraries where the algorithms are defined are separate from the library where the model behaviour is defined. Figure 15 shows the relationship between the interfaces and classes which actually implement this behaviour. Nodes in the model layer keep a reference to a series of IAlgorithm and IAlgorithmNode implementations. One IAlgorithmNode is stored as the current algorithm. When the node wishes to route a packet or trigger an algorithm to be visualised it does it via the IAlgorithmNode interface. IAlgorithmNodes are created using the IAlgorithm interface and instances of IAlgorithm are instantiated dynamically at run time. IAlgorithmNodes interact with model nodes through the IMNode interface which gives access to information such as what links are connected to a node which allows the algorithm to run.

The second extensibility mechanism is how the control module is designed. The control implementations form an inheritance hierarchy. At the top is the Control class which tracks the relationship between all entities *(what links link what nodes etc.)*. This class provides a series of protected utility methods for querying this information and exposes a range of protected events that will be triggered on user input such as a router being touched or a link being deleted. Next the SandboxControl class extends Control. This class exposes no methods at all but registers with the listeners defined in Control and parses this information to produce the Sandbox behaviour described earlier. Any programmer wishing to alter how the system is interacted with just has to extend one or other of these classes and register with the various listeners to define how the system reacts to different user inputs.

Evaluation plan

So far the focus of the project has been on getting the software to a production level. The software has been deployed on a number of platforms and the UI informally evaluated for usability. Part of the development process was designing unit tests to test the functional requirements of the system. What remains to be done is to formally evaluate Routing Island as a learning aid.

Unit testing

Unit tests have been carried out. The modular, decoupled, nature of the system makes it perfect for unit tests. Unit tests have been used to test for functional correctness. They check that the algorithms are producing the correct forwarding tables and that user input is correctly interpreted. These tests give us the confidence to start planning user evaluation without worrying that small bugs and usability issues will disproportionally affect the results.

Stress testing

Stress tests are being developed. They are implemented as controllers which can generate large numbers of events to model different usage patterns. Stress tests give quantitative results which will try to show the parameters in which it can be used and how well it satisfies the non-functional requirements. The most important testing will be qualitative user evaluation.

User evaluation

The point of the system is to help students learn about routing algorithms and engage them with the material in a new way. If students don't find the system helpful it still has merit as a piece of software engineering and still demonstrates the potential of virtual worlds but fails in its primary purpose. User Evaluation is ready to be conducted to judge whether the system succeeds on this level and how it can be improved.

The evaluation plan will be to integrate Routing Island into taught networking courses which are given every year. Students will be presented the material in a traditional classroom environment then given access to additional 2D resources, both book based and online. Once familiar with the theory of the algorithms they will be brought together for a lab session where they will work on Routing Island. They will be given work sheets which force them to interact with the system in sandbox mode and test their understanding of the algorithms. Having experienced the system they will be given a series of questions focused on finding out how effective the system is as a learning aid.

This process will be conducted twice. Once in first semester with Masters students. Their feedback will be used to make changes to the island, its integration into the taught course and how the evaluation is conducted. Once these changes have been implemented the system will be presented to undergraduate students in second semester. The results of these test sessions will form the basis for the formal evaluation of the system as teaching aid.

As well as structured, rigorous evaluation done in the department the system will also be opened up online and the code released open source so those interested in the system can see how it works and public feedback can be taken on board.

Conclusion

This paper has outlined the development of Routing Island, a learning aid for Internet Routing algorithms developed within a VW. In doing so it has described an entirely new way of working in VWs that unlocks their power to a whole new range of developers. Developers who wish to gain the benefits of working with VWs but need more power than is available via traditional scripting mechanisms and do not wish to invest in working directly with the VW platform now have an alternative. They can write code that is as complex as they wish externally using an API which gives direct and simple access to the in-world scenegraph. This code can then be easily plugged into and tested with the VW. The plug in mechanism outlined is sufficiently generic that it can be implemented in any virtual world platform.

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Social Conferencing in a Virtual World: The Innovative Approach of The Virtual World Conference

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Abstract

In this paper the authors present the organization of a virtual world conference that brings together top international researchers and pioneers in the fields of research and application of virtual worlds from academia, education, and industry. The authors outline the successes and challenges of adopting the approach of structuring the global conference into three equidistant major time zones – East, Central, and West – resulting in a 24-hours worldwide event. The paper presents analyses of questionnaires that were completed by attendees, in an attempt to test the central hypothesis that virtual worlds can support engaging and effective conferencing. We present innovations that we apply for the second edition of the conference and close the paper with suggestions and novel ideas for future virtual world conferences.

Introduction

As a result of globalization, distributed work teams and groups of researchers travel more and more for international projects and to attend conferences on all continents. Financial cost, time spent, and the impact on the environment that international travel causes are all high, and many companies, organizations and institutions are looking for alternative methods for bringing people together.

Over the last few years, virtual world platforms have proliferated. A range of platforms, such as ActiveWorlds, Second Life, OpenSim, and Olive, that allow for large numbers of people to experience co-presence in virtual environments are being used widely in many diverse fields. Conferencing in virtual worlds is becoming an increasingly popular solution. It has the immersion to make participants feel engaged and part of the group *(Schroeder, 2006)*, and has the ease of access and low costs that enable participants to take part from their offices or homes or even on the move without missing out on the socializing aspects of the conference. However, one of the major issues with using virtual worlds to support synchronous meetings lies in the imposed limits of physical world time zones; while users within a continent can relatively easily overcome the time zone barriers, when working between several continents, 6-8 hours differences can be difficult to reconcile.

The authors have collectively over twenty-five years experience of working in immersive virtual environments. The common focus of the team from different disciplinary backgrounds including computer science, psychology, educational research and collaborative work and organizational behavior has been on how social collaboration can be best designed and supported in virtual and hybrid spaces. Social collaboration in virtual spaces has been

investigated in psychological studies *(e.g. Hasler, in press)*, in education research fields *(e.g. Peachey et al., 2011; Peachey et al., 2010; de Freitas et al., 2010; de Freitas, 2006)* and from computer science, Human-Computer Interaction *(HCI; e.g. Schmeil et al., in press)*, and Computer-Supported Cooperative Work standpoints *(CSCW; e.g. Schmeil et al., 2009)*. Since the different areas traditionally focus upon different aspects, the research team that organizes The Virtual World Conference represents a rare collaboration of these perspectives, creating the opportunity for a rich reflection on our shared experience.

The initial purpose of the conference was to bring together aspects of two physical conferences *(the Serious Virtual Worlds and ReLIVE conferences, both based in the UK)* into one virtual world conference that complemented both and provided a platform for wider international dissemination, collaboration and networking. The virtual event felt increasingly appropriate in a period where budgets to attend physical conferences are rapidly diminishing, and global considerations increase the wider arguments against international travel. For example with speakers and delegates from around the globe, the benefits of holding our conference in a virtual environment are apparent in air miles alone. Rough calculations, allowing two-thirds of delegates to be one-third of the planet away from the conference home in Milton Keynes, suggest that 500,000 miles were travelled virtually to attend the conference. This reduces the environmental footprint of the conference, and saves on the time and cost of being out of the office for days either side of the main event, along with the conference fees needed to fund physical facilities. Even better, for one small delegate fee, colleagues could share a single avatar, or project the conference on to a large screen for group viewing.

In order to be truly global the idea was born to organize an event spanning 24 hours, divided into three equidistant conference time zones of 8 hours each: East *(Asia, Oceania)*, Central *(Europe, Africa)*, and West *(the Americas)*.

With this pioneering approach, we felt the need to implement a design science research *(DSR; Hevner et al., 2004)* approach: The Virtual World Conference *(TVWC)* is subject to perpetual redesign; each year the conference and its format and organization is evaluated, and is redesigned based on the analyses, comments of attendees, and further trackable data.

The paper first gives a background of virtual world conferences and other events, describes the case of TVWC, presents the evaluation of its first edition, discusses resulting implications for its second edition, and closes with suggestions and novel ideas for future conferences in virtual worlds.

Conferences in virtual worlds

Many inworld conferences took place before The Virtual World Conference, for example a Second Life event for surgeons was very successful *(Kinross et al., 2009)*. However while there had been other attempts at conferences engaging audiences across time zones *(most notably VWBPE: Virtual Worlds – Best Practices in Education)*, The Virtual World Conference was, as far as we are aware, the first to have adopted a twenty-four hour approach that worked with the natural day of speakers and audience.

In previous conferences held by the Serious Games Institute in the UK a hybrid model of combining physical conference space and lectures with remote participation *(through inworld avatars)* had been developed; the first conference of this kind, Serious Virtual Worlds, was held in September 2007 with the launch of the Serious Games Institute *(SGI)*. The event was well attended, both inworld and in the physical world. The virtual event however merely projected the actual event back into the Second Life auditorium *(via video stream)*, and the link back to the physical conference was not established. For the next year Serious Virtual Worlds established a two-way communication system, and now inworld participants could ask questions and even present from Second Life lending a more international flavor to the event, and testing the streaming technology. From 2007, the Second Wednesday monthly events were also piloted using the same technique, but held every month. These events brought 4-5 speakers a month into the virtual and physical hybrid event spaces, and remote participation with the events is still significant now.

The IEEE Virtual Worlds and Serious Games conference *(VS-GAMES)* in 2009 also adopted the hybrid model of virtual and physical presence. The main observation from the experience of hosting events in both settings is about the wider reach that has been established and the community that has been formed and supported through the three years, but also the connection of the community to industry gives the collaboration a focus upon physical world application of theory, and a strong connection with practices in education, health and the environment. Collaboration is the watchword of this type of community building, and supporting communities over long periods can be difficult but also rewarding. Intellectually, it has led to many new synergies being created, in particular innovation is well supported through this approach due to the cross-disciplinary backgrounds of participants. Communities of interest as well as practice *(Wenger, 1998)* emerge over time and people between sectors seem to become much more cohesive after several meetings.

The Virtual World Conference approach

The organization team of TVWC 2010 was composed by four conference chairs *(2 in the UK, 1 in Hong Kong and 1 in California)*, two technical helpers in the UK, and a student volunteer in Turkey.

Scope

We titled the conference unambiguously The Virtual World Conference for its aim to cover applications of virtual worlds in the most diverse application areas, research done in and on virtual worlds, and current and future developments, also including combinations with real and other digitally-augmented environments. The name says it all: it was chosen to stand for diversity, manifoldness, and collectivity, on all aspects of virtual worlds. With its innovative, dynamic approach and yearly redesign we further aim to showcase a new understanding of just what the medium can be good for.

Timing Structure

The event was organized as a 24-hour around the world event, moderated by one chair for 8 hours each *(two co-chairs in the Central time zone)*. All presentations in all time zones were open to be attended for registered delegates, although it was expected that most delegates would spend core time in their own time zones. Table 1 shows the conference schedule to illustrate the timing structure of the conference and the timings of the talks in the East *(E)*, Central *(C)*, and West *(W)* for the other time zones. Conference presentation slots are in bold font in their respective time zones, night times are grayed out. With this timing structure, we aimed for each attendee to be able to attend all presentations in the time zone closest to their location, plus an additional 4-8 presentations of other time zones, by sacrificing some evening leisure time for it. Note that attendees were not only located in one of the three time zones, but rather dispersed in all time zones in between. We also informally decode TVWC as *"The Virtually Worldwide Conference"*.

Conference Environment

The 2010 event was hosted entirely inworld on a UK Open University island in the virtual world Second Life, which was chosen as the most popular immersive environment of the moment *(Kirriemuir 2009)*. The spatial organization was conventional: rows of seats for the audience, directed towards a speaker podium that was flanked by two big screens – a bespoke slide presenter displaying the current presenters' presentation slides, and a video screen that could play videos from elsewhere on the Internet. This convention was a deliberate action, reflecting that the key drivers for being in the virtual world were considerations of physical practicalities rather than innovation. Providing a familiar space, icons and artifacts meant that both speakers and delegates would be comfortable with their environment and free to concentrate on the content rather than the delivery of presentations.

	West(UTC - 8)	Central(UTC +/-0)	East(UTC + 7)
E: Speaker 1	17:00	1:00	**8:00**
E: Speaker 2	18:00	2:00	**9:00**
E: Speaker 3	19:00	3:00	**10:00**
E: Speaker 4	20:00	4:00	**11:00**
E: Lunch	21:00	5:00	12:00
E: Speaker 5	22:00	6:00	**13:00**
E: Speaker 6	23:00	7:00	**14:00**
E: Speaker 7	0:00	8:00	**15:00**
C: Speaker 1	1:00	**9:00**	16:00
C: Speaker 2	2:00	**10:00**	17:00
C: Speaker 3	3:00	**11:00**	18:00
C: Speaker 4	4:00	**12:00**	19:00
C: Lunch	5:00	13:00	20:00
C: Speaker 5	6:00	**14:00**	21:00
C: Speaker 6	7:00	**15:00**	22:00
C: Speaker 7	8:00	**16:00**	23:00
W: Speaker 1	**9:00**	17:00	0:00
W: Speaker 2	**10:00**	18:00	1:00
W: Speaker 3	**11:00**	19:00	2:00
W: Speaker 4	**12:00**	20:00	3:00
W: Lunch	13:00	21:00	4:00
W: Speaker 5	**14:00**	22:00	5:00
W: Speaker 6	**15:00**	23:00	6:00
W: Speaker 7	**16:00**	0:00	7:00

Table 1 Schedule of The Virtual World Conference 2010

The Second Life island environment has an externally imposed limit of 100 concurrent users, and conference registration was restricted to manage an expectation of no more than around 60 users at any time in order to reduce lag and manage an optimum experience for the participants.

Figure 1 shows the inworld setup for TVWC 2010. The speaker podium contained the controls for the video screen.

Selection of speakers

Following the conference goal of addressing global challenges, we invited 21 speakers whose reputations suggested that their experience would inform a discussion on the opportunities for virtual worlds to address some of the core issues in contemporary society. We asked speakers to consider how virtual worlds can change the way that we learn, work and socialize, and invited them to select a focus from:

- Social interaction, societies and communities in virtual worlds
- Business applications and strategies for using virtual worlds
- Formal and informal teaching and learning in virtual worlds

Most of the speakers were familiar with Second Life but a small minority needed additional support to get an avatar and become familiar with the interface. All speakers were asked to submit their slides and video in advance of the event, and were invited to meet their session chair and technical support inworld for logistical and technical checks in the week leading up to the conference.

Management and administration

Like any other international conference, The Virtual World Conference is supported by a website *(http://thevirtualworldconference.org)* to inform about dates, presenters, chairs, registration, and the conference program, showing abstracts of all presentations *(the 2010 website is archived at www.thevirtualworldconference2010.org)*. A low registration fee for all attendees covered web hosting expenses and other organizational costs, as well as providing some measure of assurance that registered delegates would take up their places in the restricted space

As an aside it is worth noting that the area of cost would make an interesting topic for further research, as the real costs of hosting the conference were considerably more than the income derived, but a discussion thread in a community mailing list at the time suggested that some people felt that all virtual world events, without exception, should be free to attend.

Participants of the Survey

27 participants of TVWC *(6 speakers, 19 attendants, and 2 who did not specify the type of their participation)* replied to the survey. 18 participants were from the Central, 7 from the West, and 2 from the East time zone. Most of the participants *(85%)* reported to be frequent virtual world users. Only two participants rated themselves as occasional users or newbies. Two participants did not provide information about their virtual world experience. Second Life was the most frequently used virtual world *(25 mentions)*. Participants stated that the main interests pursued in virtual worlds were educational purposes *(36%)*, followed by research *(28%)*, business *(16%)*, collaborative work *(16%)*, and design/arts *(4%)*. 81% of the survey participants had attended events in virtual worlds before; TVWC was the first inworld conference for only 5 of them.

Quantitative Evaluation

Technical aspects. Participants were required to rate the quality of technical aspects of TVWC on a scale from 1=very poor to 4=very good. The results are summarized in table 2. Technical aspects were overall rated as very positive.

Items	Rating		
	N	M	SD
Sound quality (could understand the speakers)	27	3.44	.70
Graphics (could see the environment/people)	27	3.48	.58
User experience (could communicate/navigate)	27	3.41	.69

Table 2 Mean ratings and standard deviations of technical aspects of TVWC

Evaluation of The Virtual World Conference 2010

A link to an online survey was sent to all attendees and speakers one week after the event to evaluate various aspects of TVWC and collect opinions and ideas for improvement.

Setting

The setting of TVWC was evaluated with several aspects that were rated on a scale ranging from 1=very inappropriate to 4=very appropriate. The results are summarized in table 3. The results indicate that attendees were in principle satisfied with the setting *(this results though might have been influenced by the choice of the word "appropriate"*, because free-form comments suggest major changes to the conventional design, see below).

Items	Rating		
	N	M	SD
Arrangement of seats	27	3.37	.63
Arrangement of slides/video screens	27	3.37	.63
Speaker space	26	3.27	.60
Location of conference program	27	3.22	.70
Location of posters	27	3.15	.60
Timing of sessions (to address the whole planet)	27	3.41	.74

Table 3 Mean ratings and standard deviations of the conference setting

Future attendance

Participants were asked to indicate the likelihood of their attendance of a future edition of TVWC. 81% of the participants were sure that they would attend a future TVWC event, and 19% indicated that they would maybe attend. None of the participants indicated that they would not attend.

Qualitative Evaluation

Participants were asked to compare their experience at TVWC with that of a physical-world conference, and to indicate the *"pro's and con's"* of virtual world conferences. In addition, they were asked to provide suggestions for improvement of TVWC for future editions. Participants' free-text responses were categorized, and the number of statements in each category was counted. The results are summarized in tables 4-6.

Category	Count
No travel (time and cost savings; ease of access)	18
Real-time feedback/discussion during presentations	10
Additional/different features (e.g., recording, sharing links)	9
Global networking	8
Flexibility (e.g., to move around physically, tune in/out)	6
Different interaction styles (e.g., relaxed, informal, intimate)	5
Comfort and convenience (e.g., home environment)	5
Ease (e.g., sharing information, information cataloging)	3
Greater variety (e.g., topics, speakers)	3
24 hour schedule	1

Table 4 Subjective pro's of virtual world conferences

Category	Count
Lack of socializing/networking possibilities (e.g., no lunch)	10
Technical problems	7
Not enough dialogue/interaction between participants	4
24 hour schedule (e.g., missing talks, losing attention)	4
Face-to-face aspects missing (e.g., no real names/faces)	4
Too close schedule/information overload	4
Inadequate presentation styles (slides/video)	3
Overloaded chat (too much info, not enough time to respond)	3
No visual feedback from audience (e.g., speakers felt isolated)	2
Issues with sharing materials	2
"Value for money" (e.g., no "freebies")	2

Table 5 Subjective con's of virtual world conferences

As anticipated, the biggest advantage of using virtual worlds was considered to be the fact that no travel is involved to attend a conference, allowing greater flexibility and convenience while attending the conference. Also the great variety of topics and speakers was valued. On the other hand, the lack of the no longer necessary travel was at the same time seen as the biggest disadvantage, as it prohibits most possibilities for networking, *(face-to-face)* dialogues, and socializing. Another cause for the lack of social interaction was considered to be the schedule, which was rated to be very dense; it was suggested to stretch it out, in favor of more informal social interaction and breaks.

For the topic of supporting interaction it was further suggested to introduce ways to actively foster mingling and networking, using features that are unique to virtual worlds. The conventional setting of the conference – basically copied from physical world conference setups – was criticized. This aligns with comments on the presentation style, where the use of virtual world tools was missed, as well as the use of visual cues and a solution to the information overload in the Second Life chat window *(caused by everyone chatting in the same window, often discussing multiple topics at the same time)*.

Last but not least, technical problems were mentioned *(mostly due to the Second Life viewer and platform)*, and more help for newbies and technical support would be appreciated.

Implications for the next edition

The date for TVWC 2011 is September 14th, 2011. This second edition of The Virtual World Conference introduces some innovations and alterations to the ways the conference was organized in the first run, which we have derived from the evaluation analysis and comments from the attendees and presenters. This section provides an overview, along with explanations to each innovation.

Category	Count
Presentation style (e.g., slides could not be displayed, more interactivity, inworld presentation skills)	8
Foster mingling/networking (e.g., enable small group discussions)	5
Guidance for newbies (e.g., use of camera; etiquette)	5
24 hour schedule (more time/stretching the timetable)	5
More information on participants (e.g., bio of attendees)	4
Setting (e.g., rows and lecturer; satellites instead of 1 room)	3
Scope (e.g., open call/not limited to invited speakers; more frequent meetings and focused on themes)	3
Technical (e.g., SL alternatives, other presentation tools)	3
Archive materials	3
Presentation style (e.g., slides could not be displayed, more interactivity, inworld presentation skills)	8
Thematic sessions/division	2
Conference announcement (earlier, more/better marketing)	2
Make use of embodiment (avatars/3D space) (e.g., visualize when avatars have ideas/questions; include virtual field trips)	2
Value for money/ no payment for virtual conferences	2

Table 6 Suggestions for improvement

Schedule

The second edition of TVWC introduces a less tight schedule. Instead of 21 speakers, each time zone has merely 5 presentations, resulting in a total of 15 conventional talks. The presentations are further limited to 30 minutes, leaving another 30 for discussions or activities, before the next slot.

Format

All talks are divided into two sessions for each time zone, while keeping the highly valued diversity of topics. Apart from the 15 invited talks, TVWC 2011 includes networking periods and designates time for informal mingling, engaging activities and planned discussions. Also a focus group is offered to capture the best of each zone's discussion and feedback.

Real identities

The possibility of displaying real names above the avatar name is provided, in an non-obtrusive way. During the talks, the presenters' pictures, short biographies, and links to personal and/or project websites are displayed on a dedicated screen, so that attendees are more aware of who is presenting and have immediate access to further information.

Tool use

Presenters are not limited to only slide show and video player as tools to support their

verbal narration, but also a voting/polling tool at their disposal, in order to better include the audience in the presentations and discussions.

Participation

Throughout the conference, many boards offer the possibility for attendees to leave comments in form of objects that attach to the boards upon click. This is useful for adding questions to abstracts before presentations *(so the presenters can tailor their talks to the interests of the audience)*, for adding comments to particular slides or posters, for leaving notes and contact information to others on whiteboards, and for writing on whiteboards in general. Other boards are equipped with a movable arrow, to point to a certain spot on it, for example on the current slide.

Networking

At the beginning of each time zone 'chapter', networking games and activities are offered, making use of the attendees' virtual embodiment *(i.e., their avatars)* and their ability to navigate in 3D space. Interactive tools and a responsive environment will be used to create memorable experiences and persistent impressions. For the hour-long lunch break, semi-formal discussion rounds are organized, centered around topics taken from the preceding talks. At the end of each time zone chapter there is more time to network and discuss.

Collaborative Innovation

The focus group aims at creating innovative virtual world collaboration patterns for future editions of TVWC. Moderated by one of the conference chairs, attendees and invited speakers work on ideating novel practices for conferences and other social events in virtual worlds. This way The Virtual World Conference is forced to remain in its iterative redesign cycle *(cmp. design science research)*.

Setting

Harnessing the virtual world features of the availability of abundant 3D space and the possibility of scripting responsive environments and interactive tools, the conventional conference setting *(lecturer-audience, static presentation slide and video screens)* gave way to a dynamic platform accommodating the presenter and the audience; it moves back and forth between a persistent row of presentation slides in a spiral set up. Instead of switching slides on a static screen, the entire conference session moves along a path of presentations, traversing different topics, so to speak. Our basic policy is that every object has a function, in comparison to other virtual world events that focus on architectural extravagance and/or detailed decorations.

'Freebies'

All attendees receive an electronic version of the proceedings of The Virtual World Conference, including presenter biographies, abstracts of their talks, presentation slides, and possibly an edited version of the chat log of their session. These 'proceedings' will not otherwise be published.

A plausible future of online conferences

In future editions of this conference – or other virtual world events, for that matter – the following ideas could be considered.

Automated presentations

Talks could be pre-recorded *(in better audio quality)*, possibly edited, cut into pieces and attached to single slides, or just paused and resumed with buttons. The real-time interaction should focus more on the discussion; the speakers themselves could so join the discussion in text chat during their own talks.

Main caveat: The talk (the audio recording of the presentation) might run the risk of getting pushed in the background and losing its central role.

Interaction

Instructions for speakers on how to prepare their talks could be offered and live support could be given. This could allow for more engaging and effective methods of involving the audience using avatars, the 3D space, interactive objects, and external tools.

Main caveat: The content of the presentation might run the risk of getting pushed in the background, with too much attention on the use of novel tools.

Metaverse

Virtual field trips within Second Life and in other virtual worlds could be organized, and informal gatherings could be held between the main conference events *(e.g. virtual lunches)*.

Main caveat: Field trips often end in losing most of the group while teleporting. With the abundance of virtual world group meetings, an innovative format has to be implemented.

Cross-media format

A combination of the real-time event in the virtual world and social networking tools might be a successful format fostering networking among participants.

Main caveat: Using cross-media approaches for social events is prone to end up in splinter groups, with attendees drifting off to different platforms.

Interest Communication

Attendees could be given hats or other props in different colors that display their main interest in virtual worlds

Main caveat: Too many props could clutter the conference.

No proprietary software, no/fewer costs

A switch from Second Life to the OSGrid as a location for The Virtual World Conference – or another virtual world based on open software – seems appropriate, already for technical glitches and limitations imposed by Linden Lab. In line with this, sponsors could be found *(e.g., a virtual world news media channel)*, in order to cancel out the registration fee.

Main caveat: Second Life is – still – the most popular virtual world, and the platform people think about when they hear The Virtual World Conference.

Summary and conclusions

The paper has presented The Virtual World Conference, describing its organization, unique format, and the novel and innovative approach of redesigning it immensely each year. Its first year attendees greatly valued this new conference format, and expressed excitement about the event in general and participating in a live 24-hour event around the world in particular. We have presented the lessons learned from the first edition of TVWC and described how we implemented them in the redesign of the event for its second run.

In summary, while we have replicated a physical conference in the first edition of TVWC, the second edition will try out more innovative scenarios concerning the organization, format, setting, and use of tools, and will introduce more varied elements to the program. An evaluation after TVWC 2011 will hopefully provide more insights on whether we move into the right directions, and inform the redesign of the event for its third edition in 2012.

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Second Life Virtual Hazard Detection

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Abstract

Second Life hazard detection exercises were built to enable students to undertake their hazard detection training in a safe and controllable environment free from the expense of building a physical simulation. This paper covers the issues of designing an educational simulation in virtual space from a technical point of view (how to build reusable code) and a pedagogical point of view (how to design a virtual hazard). Five different hazard detection simulations were built for the students of quarrying, environmental health and occupational therapy. The code for the exercises was designed to be reused in each simulation, with little customization, to reduce the costs of development. When the finished exercises were presented to students the students were surveyed as to their view of the success of the exercise although more students will need to be surveyed to prove all the findings. The overwhelmingly positive feedback suggests that the construction of the simulations was a success and using virtual worlds for hazard detection exercises and assessment is of great value to students. Although there are technical and financial obstacles attached to creating and delivering this sort of exercise the benefits to the students make it worth overcoming these obstacles.

Introduction

There are several areas of professional training where virtual world simulations have advantages over real world simulations. One well documented area is in the provision of medical training *(Heinrichs et al, 2008;*

Danforth et al, 2009; Holloway, 2010) another less well documented area of training is in the simulation of hazardous environments. This paper describes how a hazard detection exercise was developed for a Second Life quarry and how the code for that exercise has been developed so that it can be reused in other hazard detection simulations.

Not only dangerous situations have been simulated, but situations that are too expensive or impractical to set up in the real world. Using the same base code as the quarry exercises, two environmental hazard detection simulations were built. These were set in a domestic house and a first floor maisonette flat that included the communal areas. The environmental hazard house simulation was further adapted for an occupational therapy hazard detection exercise.

In this paper we look at the problems of how to design a virtual hazard in a way that would make a student click on it due to its appearance alone, how to represent non-visible aspects of a hazard and how the students will interact with the hazards.

Throughout this document the objects that are referred to as *"hazards"* are objects that are potentially hazards and can be clicked on by students as part of the exercise. They may not actually represent something that is hazardous.

We also look at the advantages of designing reusable code and how the code is used and adapted for the different hazard detection exercises.

Finally we look at how the students responded to the virtual world simulations, and whether the skills learned in Second Life are transferable to the real world *(Jarmon et al, 2009)*. The results of the student survey revealed some encouraging and surprising results, and showed that the students were fully engaging with the exercises.

Background

The quarrying industry has had a poor record when it comes to health and safety *(Foster, Parand & Bennett, 2008)*. Derby University has been working with the Institute of Quarrying for several years. The University creates learning materials and provides facilities for corporate training of quarrying students. As part of this collaboration the Institute of Quarrying provided funding to develop a virtual quarry in Second Life. Phase one of this project was to model the quarry, providing a realistic quarry simulation complete with hazards, moving vehicles and including an exercise to assess students on the procedures stated in Andrew, Bartingale & Hume, *(2011)* for blasting rock out of a hard rock quarry. The interactions were built in accordance to Antonacci & Modress, *(2008)*. This paper looks at phase two of this project which was to build a detailed workshop within the quarry and provide two exercises, one a hazard detection exercise within the workshop area, and the other a hazard detection exercise for the rest of the quarry. Fig. 1.

During the planning stage of phase two of the virtual quarry we were also approached by the

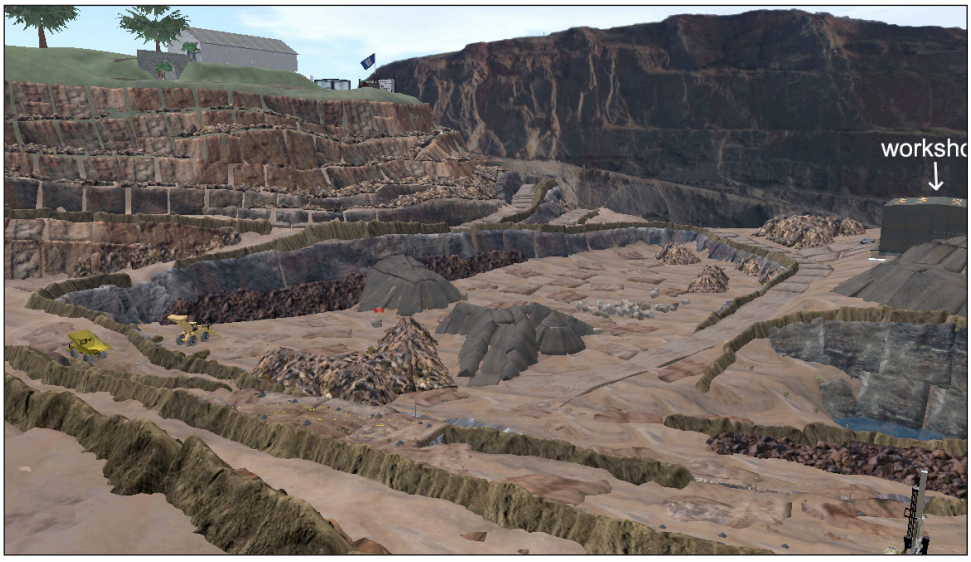


Figure 1

The Quarry, including the workshop. http://slurl.com/secondlife/Institute%20Of%20Quarrying/52/213/86

Environmental Health Department with regards to converting a 2D Flash exercise *(Bristol City Council, 2011)* into a 3D virtual house. The house would contain many different types of hazard as outlined in Matte & Jacobs *(2000)* and Krieger & Higgins *(2002)* and would be used as a training exercise for environmental health inspectors. The University was previously renting a rundown house set up with a selection of hazards. This is obviously an expensive option. As these two projects started together, it was decided to create code that would be reusable and do the job for both clients.

After the initial build of the environmental health house was completed, additional funding was acquired for phase two of the environmental health house. This was to build a block of maisonette flats *(Fig. 2)*, and to include communal living areas as well as fully fitting out one of the flats. Setting up hazards in the communal areas of real block of flats would obviously infringe safety regulations.

After the environmental health house was finished the results were shown to staff members from the occupational therapy department. They could see that with a few small changes their students would be able to take advantage of it as well. Following on from this one of the empty flats in the blocks of flats *(Fig. 2)*, was fitted out as the home of an elderly widower in a poor state of health. The flat contained furniture and personal possessions. These possessions were chosen to give the students clues as to the character and state of physical and mental health of the occupant of the flat. The exercise required by the occupational therapy department was slightly different to that required by quarrying and environmental health as the answers to the questions are all subjective and dependent on the information given to the students beforehand. This exercise was also designed to prompt discussion rather than to test ability.

The occupational therapy course had different requirements for the exercise some, of which are outlined in Stevens Holman & Bennett *(2001)* and Carter et al. *(1997)*. The code from the quarry and environmental health house was used as a starting point. The code was changed to store the answer given rather than the score, and the feedback was changed to display their chosen answers so that after the students had completed the exercise they could compare results in the class. Reusability of the occupational therapy flat comes not from changing the virtual environment but from changing the situation. Before the students start the exercise they are told something about the situation of the occupant and asked to assess the flat based on this information. By having a range of different scenarios to give to the students before they start the exercise, it is possible for the same students to use the exercise more than once and produce a different set of results each time.



Figure 2 The Environmental Health House and Flat, and the Occupational Therapy Flat
http://slurl.com/secondlife/Derby%20University/125/106/22

The Problems of Representing Identifiable Hazards in Virtual Space

Many papers have been written about how to design educational virtual worlds *(Shailey & Reeves, 2010; Bignell & Parson, 2010; Girvan & Savage, 2010; Hew & Cheung, 2010)* but one of the problems not mentioned that had to be overcome was how to represent a hazard. Some types of hazard are easy to represent such as a broken power socket or an oil spill. These can be represented by modelling the hazardous item and clicking on that item to identify it as a hazard, but how do you click on a missing item of safety equipment? This was solved in two ways. One was by having the safety equipment present but not in use or not in the correct location. The other way was to unambiguously show where an item of safety should be so that its absence is obvious and there is no doubt about where to click.

Another problem is that of scale. Anyone who is familiar with Second Life will know that everybody chooses an avatar that is 7 feet tall. This causes a problem of how to represent scale. When we first built the house for the environmental hazards exercise, we built it at a scale of 1:1 and we limited access to avatars that were shorter then 6'4" *(1.95 meters)*. This gave an accurate representation of scale and it was easy to judge things like the height of doors and windowsills. However at a scale of 1:1 you encounter perspective problems, and problems navigating through narrow hallways. These manifest themselves as the camera constantly moving through walls and as a close up of the back of the avatar's head. With the camera constantly changing, users were feeling disorientated and in some cases experiencing motion sickness. This was also noted in Dickey, *(2011)*. After a short trial it was decided to increase the scale of the house by 25% to 1:1.25. This maintained the proportions of the house and made navigation through it a more natural experience, but it also gave us the problem of how to represent hazards that were height-related. This was solved in two steps. The first was to exaggerate the height issue to prompt the student to click on the item. The second was to give additional height information in the text of the multi-choice question.

Another scale issue was audio volume, i.e. not knowing what volume the student has the computer set to. How do they identify whether a noise is at an acceptable level? For noise hazards we solved this issue by having a noise meter in proximity to the source of the noise and the reading on the meter showed whether it was a hazard or not.

Subtle hazards such as water leaks that could be easily missed visually were linked to sounds so that students would be given a clue as to what to look for.

We had several requests for hazards linked to NPCs *(Non Player Characters or characters controlled by the computer)* ignoring safety procedures. We had to abandon all the hazards requiring NPCs to walk around. This was for two reasons, one was due to the limitations in animating NPCs in Second Life, the other was because, if the NPC was walking around, the hazard would not be obvious for 100% of the time, so the student may not be present while the NPC is infringing safety regulations. In the hazards we did include that required NPCs, the NPCs were static and the hazards were continuous, such as welding without a mask *(Fig. 8)*, and grinding with sparks flying on to flammable liquid *(Fig. 6)*.

Exercise Procedure

The exercises are designed so that multiple students can take part at the same time.

As recommended in Bignell & Parson *(2010)*, to start the exercise the avatar clicks on an informative sign or *"Hazard Console"*. This brings up further instructions in a dialog box explaining the scoring and asking if the avatar is ready to start *(Fig. 3.)* Once the avatar clicks on the start button a timer starts and all the hazards will now react when clicked on by that avatar. The avatar now has to walk around the area of the exercise and click on objects that they regard as hazardous. This will bring up a dialog box stating the name of the hazard, any information about that hazard that cannot be gained by looking at it in detail, the question, the options, and the corresponding option buttons - one of which is always *"It's Safe" (Fig. 4)*.



Figure 3 Starting the exercise

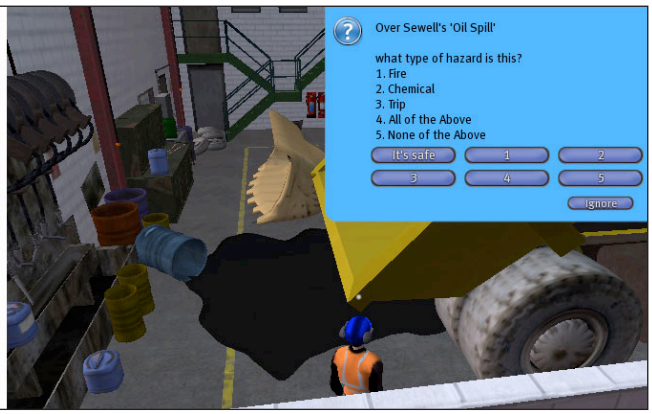


Figure 4 Answering a Question

After walking around for a while, clicking on everything you considered to be a hazard and answering the questions, you return to the sign and click on it again to receive your feedback *(Fig. 5)*. This will also happen automatically if you run out of time. The feedback is IM'ed *(instant messaged)* to you so you can see it wherever you are in world and so other people cannot see your results.

The *"red herrings" (deliberately misleading clues)* mentioned in the feedback refer to the hazards that are in their safe state. The *"red herrings correctly identified"* are the hazards in the safe state that when asked *"What type is hazard it this?"* the student responded by clicking the *"It's Safe"* button.

After the feedback has been given, if the avatar clicks on the sign again they then have the option to repeat the same exercise, and if there are currently no avatars taking part in the exercise they also have the option of viewing the correct answers. On choosing to see the correct answers, the exercise goes into feedback mode, where all the click boxes become visible with a transparency of 50%. This is to show where all the hazards are. Hazards highlighted in red are in their dangerous state and hazards highlighted in green are in their safe state. On clicking on a click box in this mode you are given some extra feedback stating the correct answer and the reasoning behind that answer *(Fig. 6)*. After a given time period the click boxes will

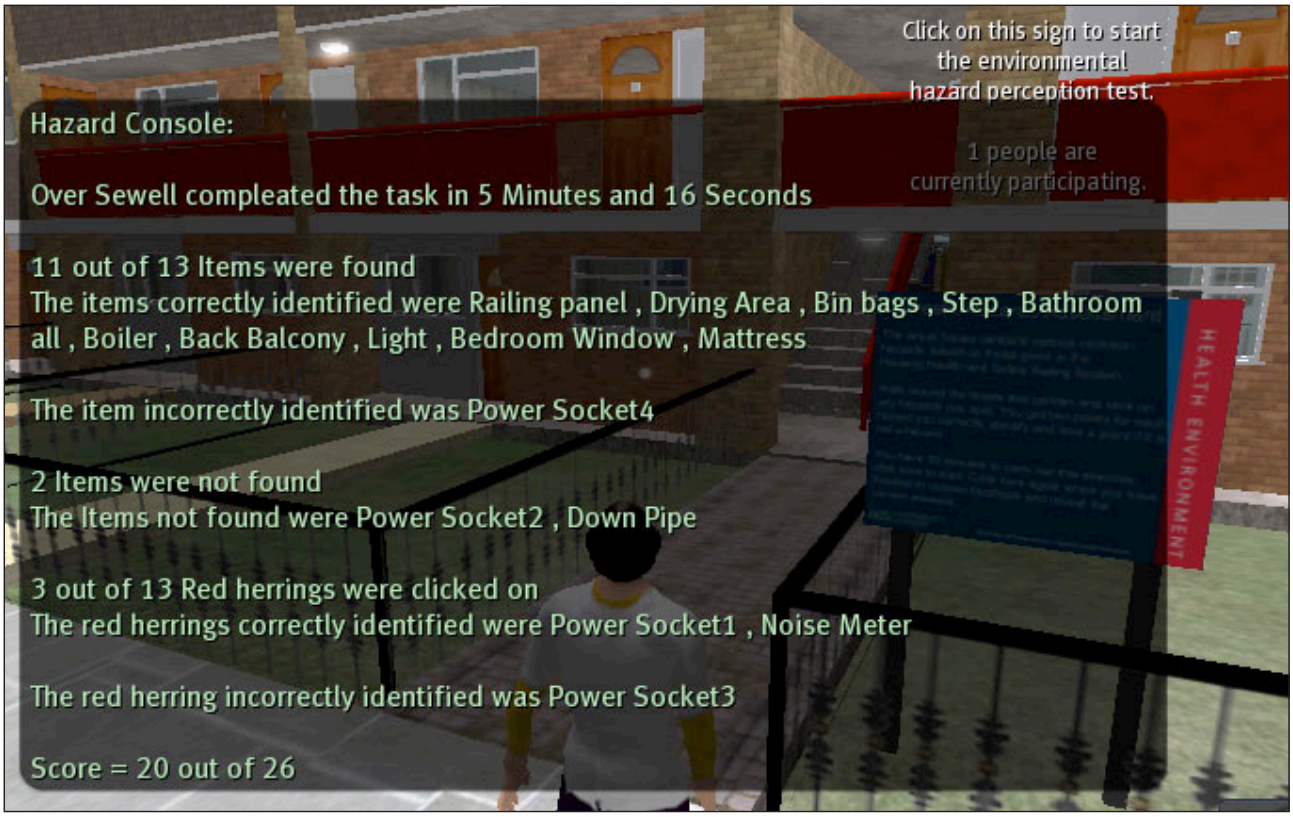


Figure 5 Instant message feedback breaking down the results and giving the score.



Figure 6 Feedback mode showing highlighted hazards and additional feedback.

hide themselves and all the hazards will be randomised again ready for the next group of students.

The occupational therapy exercise runs on identical lines except you can give more than one answer for each question. There is no feedback mode *(since there are no correct or incorrect answers)* and the feedback message, which is more of a summary than feedback, tells the student what answers they gave but does not give a score *(Fig. 7)*. The students then take this feedback back to the class for further discussion.

Virtual Objects

Each hazard detection exercise has a *"Hazard Console"* which appears in Second Life as a sign containing instructions on how to take

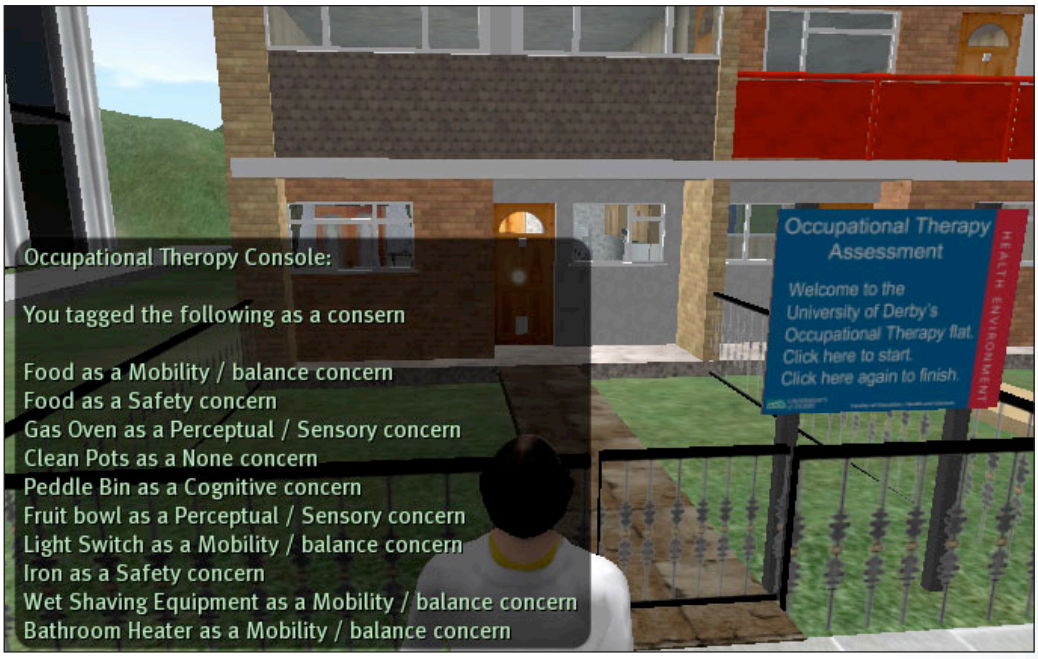


Figure 7

Feedback for the occupational therapy exercise.



Figure 8 Hazards in a dangerous state



Figure 9 Hazards in a safe state

part in the exercise, and text above the sign stating the number of people currently taking part in the exercise *(Fig. 3)*. The hazard console is the start and end point of the exercise and contains the code that links all the other objects to the exercise.

The other items relevant to the exercise are the hazards. Each hazard has two states. For the exercises we created each hazard has a dangerous state where the objects actually represents a hazard *(Fig. 8)*, and a safe state where the objects represent a situation as you would hope to see it *(Fig. 9)*.

There are multiple hazards per exercise and some of the hazards may consist of multiple objects. The hazards in the occupational therapy flat had only one state . It is up to the students to decide whether it is a cause for concern or not.

The hazards can be represented in many ways. Some examples are: an item that is visibly obviously broken and dangerous; the absence of a piece of safety equipment in a specific location such as a missing hand rail; the mounting plate for a missing fire extinguisher; no welding mask on a NPC representing a welder. Other hazards were represented in a far more subtle way: the sound of a dripping pipe combined with a water particle system; the reading on a sound meter and an over-loaded crane where you have to cross reference the weight of the load with the weight limit of the crane. You also cross reference the date marked on calendars with the retest dates of items of equipment, to see if they are within their safety tested period.

Each hazard, as well has having a visible aspect, also has an invisible click box. We chose to have an invisible item to click on for two reasons: 1- so the code could be kept in one location as some hazards are made of multiple objects, 2- the click box is used to highlight the hazards in feedback mode. They glow red for a hazard and green when they are safe *(as described in the exercise procedure section)*.

The Code

In Second Life the code that acts upon an object is placed within the object. This means that for different objects to react to each other the code from one object needs to communicate with the code in another object.

There were three pieces of code that had to be created for the hazard exercise. Hazard Console code, Hazard Send code and the Hazard Change code. The Hazard Console code can be found in the hazard console, the Hazard Send code is placed in the click box and the Hazard Change code is placed in all the objects that represent the hazard. *(Fig. 10)*.

The Hazard Console code is the main piece of code. This code communicates with the other pieces of code telling them what state to be in *(feedback or exercise mode, the dangerous state or the safe state)* and which avatars are currently taking part in the exercise. The Hazard Console code also collects the results during the exercise and times the exercise. When the exercise has finished *(either by clicking on the hazard console to finish or when time has run out)* the Hazard Console code creates the feedback message, IM's it to the student and emails it to the lecturer.

When adding new hazards the only amendments that need to be made to the Hazard Console code are to add the name of the new hazard and the scores for its questions to a list.

When reusing the Hazard Console code for a different exercise you can customise the way that it randomises the hazards. In the quarry workshop we were asked to include the option where only the chemical hazards were dangerous. This was to allow students partaking in COSHH *(Control of Substances Hazardous to Health)* training to use the virtual workshop. Another thing that has to be changed is the channel number used to communicate with the other pieces of code. This is done so that if there are two different exercises in the same region they do not get conflicting messages.

Hazard Send code is activated when an avatar starts the exercise. When an avatar taking part in the exercise clicks on the click box they will be presented with a multiple choice question giving them additional information about the hazard, they will also be asked to chose what type of hazard it is These options always include *"It is safe"*. The question and options that appear are dependent on what state the hazard is in *(safe or dangerous)*. Once the question has been answered and the data about whether the question was answered correctly or not has been sent to the hazard console, the avatar is removed from the list so that they cannot attempt the question again.

For the occupational therapy exercise the Hazard Send code, instead of sending whether the question was answered correctly or not, sends the option chosen and still allows for the question to be answered again.

Hazard Send code also controls the highlight box in feedback mode and hazard feedback message, which is also dependent of the hazard state. The Hazard Send code is the same for all the hazards with the exception of the text for the feedback messages, the text for the questions, the question options and what the correct answers are for each state.

Hazard Change code is in control of changing between the hazard's states and has to be customised for most hazards.
This code is triggered when the exercise has finished and the states are being randomised. Some of the changes it makes include changing visibility, moving objects to a different location, changing textures, changing

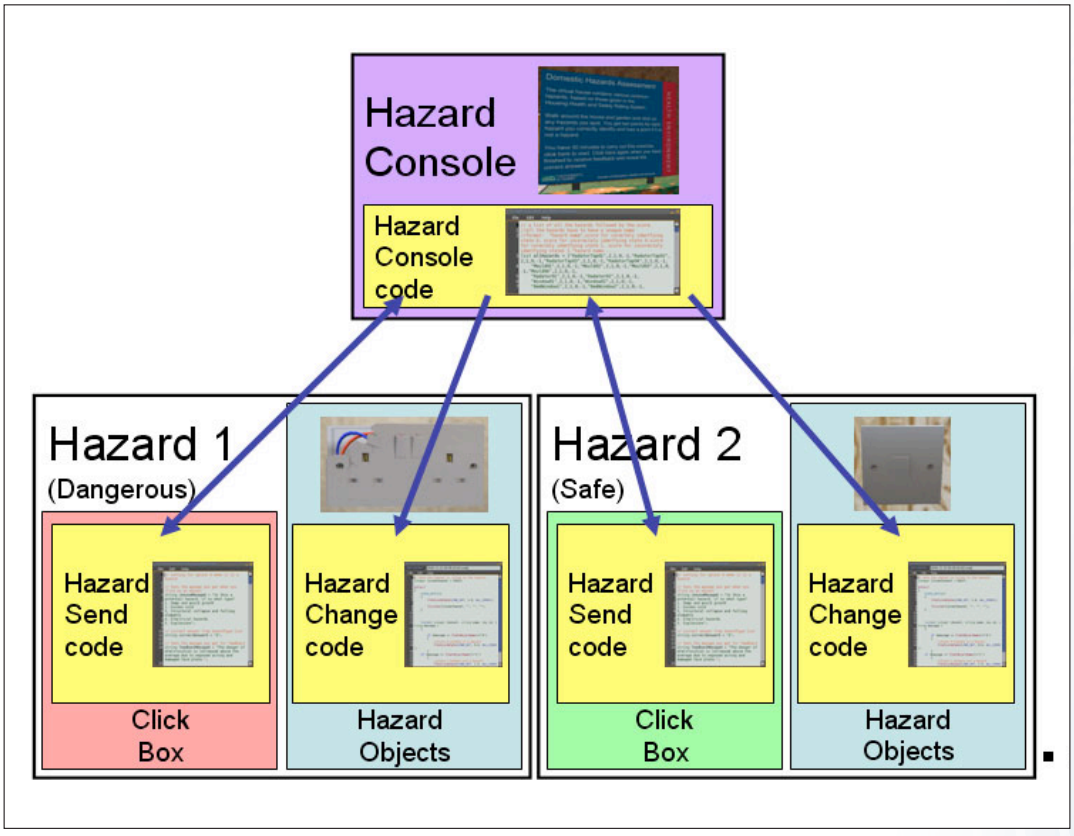


Figure 10
Code Diagram

whether an object is solid or not and starting or stopping sounds effects and particle systems.

It is customising this code that takes up the most time when setting up an exercise.

The occupational therapy exercise does not require hazard change code as the hazards only have one state.

Results

The amount of results collected was relatively low as each exercise has only been run in the classroom for one year. Nearly all students were new to Second Life and in accordance with Petrakou *(2010)* were given some time to get used to navigating with the avatar before starting the exercises.

The quarrying exercises were run as group sessions with 5 or 6 people around a PC and one person controlling the avatar that was given to them for the duration of the exercise. Three groups took part in the exercise at a time, with six groups taking part in total. The hazards were randomised between sessions. Second Life viewer 1 was used. Each session started with a quick demonstration of how to navigate within Second Life and how the exercise worked. The students were asked to do the quarry workshop exercise which takes place over an area of about 1,000 m2. During the exercise 12 of the 24 hazards were set to their dangerous state. Each group despite no previous experience with Second Life, got along straight away with a little guidance. The more advanced groups went on to start the quarry exercise with 8 of the 16 hazards set to their dangerous state. *(This exercise takes much longer as it involves investigating the whole island, an area of 65,000 m2)*.

No written survey was taken during the quarrying exercise, as it was done in the first part of a three hour session. However during a brief discussion with the class as a whole everybody seemed enthusiastic, there was no negative feedback and afterwards we received both requests to be able to access the technology for training purposes in their workplaces and suggestions for other areas of safety training that they would like to see this technology used for.

During the environmental house and flat exercises the students were in a computer lab with each student having their own computer. All the students took part in the same exercises. The environmental house had four of the 40 hazards in the dangerous state. The environmental flats had 13 of the 26 hazards in the dangerous state. The reason for the different ratios of hazard to red herring is, in the environmental house some of the hazards are duplicated in different rooms.

Each student was given an avatar for the one hour duration of the exercise. After some initial problems getting Second Life viewer 1 to run on the PCs, the students were given a brief introduction and instructed on what they had to do. They then were told to start in the environmental house. With help on hand throughout, the session proceeded without any significant problems. The only problem was getting all the students to finish the exercise when it became time for them to see the feedback. *(This was a problem because you cannot view the additional feedback while people are still logged into the exercise.)* After reviewing the feedback for the environmental house the students preceded to the block of maisonette flats located next to the environmental house to take part in that exercise which included communal areas. After reviewing the feedback for the environmental flats the students were asked to fill out a short questionnaire. This included basic demographic questions, questions about previous Second Life and gaming experience and questions about how useful they thought the exercise was. They were also given the option to leave comments at the end. All 14 students filled out the questionnaire and 8 left comments.

Some weeks before the exercise took place the students were emailed a link to the Second Life island and given brief instructions on how to take part in the exercise. Only two of the students had accessed the Second Life exercise before taking part in the classroom exercise.

With only 14 data sets statistical analyses would not be appropriate. However looking closely at the results, what stands out is that demographics were not a factor in how the questions were answered regardless of how

you break down the results by age or sex. Although no one in the class was in the 45+ age bracket. The only notable trend observed was when taking into account previous gaming experience. What was surprising was that it was the experienced gamers who were the most apprehensive about using Second Life in the classroom, and when asked *"How much did this Second Life experience help you to learn about your subject?"* only 33% of the experienced gamers responded with *"Greatly"* compared to 63% of the occasional and inexperienced gamers. This is the opposite of what we expected. We expected the experienced gamers to have fewer problems navigating the environment and therefore to be in a better position to take advantage of the experience. Only one of the 14 people seemed to have a negative experience finding it hard to get used to Second Life, and stating that they would have preferred to do a real life exercise. On the whole the rest of the class had a positive experience and while agreeing that a real life exercise would be better then a virtual one, they all said that they had learnt something from the experience.

The exercise in the Occupational Therapy *(OT)* flat was done on two days. Each day was split up into two sessions to reduce the number of avatars in the flat at a time. On the first day the exercise was carried out in a computer lab with people working together in pairs. The second day was in a classroom environment with groups of four people around a PC. For these exercises the students used the Phoenix viewer *(an alternative to the Second Life viewer)*. The questionnaire given to the OT students was based on that given to the environmental health students but it had some extra questions added by the academics.

Before entering the OT flat the students were told that the occupant had recently had a stroke and were told to assess whether the flat would be suitable for him to return to. The exercise was done as an optional extra session and not as a compulsory part of the course. 26 students participated. The vast majority of students were female so there is no useful data on gender preferences. No one in the class was in the 45+ age bracket and none of the students were experienced gamers.

The feedback was again overwhelmingly positive with most negative feedback being attributable to a lack of experience with Second Life. The only negative feedback regarding the exercise was that even at 1:1.25 scale the rooms were too small to navigate. The class on the whole were more apprehensive about undertaking the exercise than the environmental health students were. The amount of apprehension increased with the age of the student. Again it was noticed that more experience of gaming lead to more apprehension. All the students stated that the exercise would help them with a home visit and many of them stated that undertaking the exercise greatly increased their confidence in preparation for them making an actual home visit. All the students agreed that the exercise helped them apply theoretical knowledge to a practical task to some degree. When asked to compare the Second Life activity to more traditional methods most of the students agreed that Second Life was an improvement. What is surprising is that it was the younger students that placed the least value on the Second Life exercise.

The lecturers stated that use of the Second Life exercise produced a more engaged discussion when compared with the traditional classroom activity.

Conclusions

Having reusable code greatly reduces the time and therefore the cost of building a Second Life simulation. However, for the first build using the code, the time is increased due to the implementation of functionality that will not necessarily be required in that particular implementation of the code. and functionality to enable the code to be adapted easily. Reusable code should also be subjected to extra testing as when it is implemented in several locations it is harder to amend.

The number of students that have been surveyed is currently too low to give any conclusive demographic observations. Students will continue to be surveyed when their courses are rerun. Even when going by the low number of students surveyed the results from the surveys show that the students

gave overwhelmingly positive feedback, with everyone learning something from the exercise and 82.5% saying it helped greatly with their studies. It is clear also from the results that the students need more time prior to the exercise to get use to Second Life. The feedback from the students can only lead to one conclusion and that is that using Second Life *(or other virtual world simulations)* to teach and assess hazard detection skills is of great help to them. Therefore, the use of virtual world simulations should be encouraged in the teaching of hazard detection skills.

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Avatars and Aspirations - Fostering the creative potential of project management education in the Creative Industries

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Key words: Avatars, 'Learning by doing', Creative Industries project management, Second Life, analytical thinking, motivation.

Abstract

Creative Industries Management aims by its very nature to embrace new and innovative approaches to training and the sector has regarded the virtual world as a potential aid for fostering creative approaches for a considerable time. Second Life, as a 3D multi user virtual environment, enables users to transfer knowledge into practical project work while research into SL claims high value for learning.

The Experimental Learning Framework *(ELF)* is a three year research project *(2009-2012)* that investigates the potential of 'Second Life' for project management training. It aims to test the capacity of SL for learning and teaching in project management and to foster an understanding of virtual learning environments in relation to real life experience.

This paper focuses on the avatar as an embodiment of a real person in Second Life. It analyses avatar design, its workability and avatar awareness, which are discussed within the framework of reflexive methodology. Two research outcomes are presented. Firstly, creative avatar applications are analysed in the framework of 'learning by doing', which resulted in fostering creativity and personal motivation as part of the independent learning process. Secondly, the enduring comparison between real and virtual worlds as triggered and produced by the avatar supported analytical thinking skills.

Introduction

The use of virtual worlds has become a familiar feature in University education. A variety of disciplines and departments including medicine, psychology and an increasing number of UK business schools have firmly moved parts of their learning provision from e-learning to v-learning. This may not be happening as fast as the Gartner group predicted for the whole internet population in 2008, stating that 80% of Internet users would participate in virtual worlds by 2011 *(quoted in Hendaoui, Limayem and Thompson, 2008: 88)*, but the UK virtual education landscape is growing by widening its appeal into non computing related areas. Creative Industries Management aims by its very nature to embrace new and innovative approaches to training and the sector has regarded the virtual world as a potential aid for fostering creative approaches for a considerable time *(Dickey: 2003, Livingsstone, D.,Kemp, J. and Edgar, E.: 2008)*

Second Life *(SL)* enables users to transfer knowledge into practical project work while research into SL claims high value for learning *(Warburton, 2009, Antonacci and Modress 2008)*. It remains the most popular software programme of its kind in higher education, providing a platform that encourages participants to create their own virtual content. It is part of a wider group of multi user online virtual environments *(MUVE's)* that operate in real time via the motional use of personalised avatars. The majority of universities in the UK, for example, have purchased or are renting spaces or islands in SL in order to facilitate their learning and teaching practice. Linden research SL, launched in 2003 and known as Linden Lab, allocates server capacity to the owner and provides a virtual space that is sectored into regions, which are then divided into islands *(Molke-Danielsen, 2009:15)*. Second Life operates without geographical borders and anyone with a computer and reliable internet access is able to participate.

The ELF Project

The creative potential of SL as applied in a business environment has attracted research interest mainly from business community *(Bessiere et all, 2009)* while research into development and application of skills has been preferred in Business Schools. The Experimental Learning Framework *(ELF)* intends to combine both approaches. Over the last two years and as part of a three year research project *(2009-2012)* ELF investigates the potential of 'Second Life' for project management training. It aims to test the capacity of SL for learning and teaching in project management while fostering an understanding of virtual learning environments in relation to real life experience. Creative Industries Management students plan, implement and evaluate projects in the virtual world within the avatar based environment and the research project investigates if the resultant experience could be transferred into their real world skills base. Although the research focuses on skills transfer from virtual to real world applications, it considers in particular its creative potential for management solutions.

In practical terms it provides graduate level students with the opportunity to design and implement virtual creative industries management projects from start to finish. Additionally, a lecture, workshop and seminar programme supplement traditional classroom teaching. Occasionally, individual or group tutorials are arranged to counter severe weather conditions, to cater for travel cost-conscious students and to offer non-location based access to tutors. The ELF project is based at Collyer, one of London Metropolitan University's SL islands, which amongst other buildings houses the Nordstar gallery, a dedicated art space, where the majority of activities are implemented.

Project based learning experiences have long been considered as one of the most effective tools in Creative Industries Management education. However, exercised in real life, they require long term involvement, field experience, are often not cost-effective and carry a high risk of failure. Many courses therefore opt for placement-oriented practical experience instead *(Bric, 2009)*. In Second Life none of the above mentioned obstacles are relevant. Projects are implemented within the semester schedule, with a minimal budget and without the need for prior experience.

As with a real live event, students work according to a project plan that explains the idea and its embedded conceptual framework, develop a mission and objectives as well as a strategy *(including resource allocation, staffing, marketing and financial management)*. Students design their projects independently but are advised to work within the parameters of the 'Experimental learning framework' which follows four stages: foundation, participation, creation and multiplication. During the foundation stage students familiarise themselves with SL while creating an avatar and finding their way around. Typically they set up their account in SL, choose a name, body and clothing for their avatar and learn to walk and fly while either attending generic SL tutorials or studying the self explanatory introduction tools provided in SL. Additionally, a small exercise tool is set up above the Nordstar gallery to facilitate basic coordination and avatar movement. During the participation stage emphasis is directed towards communication and participation within a set environment. Students attend seminars, lectures and workshops at the Londonmet SL campus. The majority of subject field related activities such as seminars on events and exhibition design take place at the Nordstar gallery seminar area. Discussions and group work is facilitated but students are encouraged to meet and work outside the formal settings as much as possible. At this stage project planning is nearly complete and students start the implementation phase. The majority of management projects involve extensive communication with other organisers, audiences and artists that covers initial contact, commissioning of products and staff recruitment. This takes the students directly into the creation phase where project events are set into motion. Depending on the type of project, the gallery houses the event or alternatively students design and build their own event space on the island. The virtual application offers building possibilities that could not be achieved in real world situations. Many projects culminate in a particular event such as an exhibition opening, special

viewing, concert, special performance or art procession. Towards the end of the project duration an event evaluation including a self-reflective exercise is carried out that leads to multiplication, the final stage of ELF, where experiences and data are exchanged and analysed. The next cohort of project management students receive results such as marketing data and are able to decide what might be relevant and suitable for their project

Methodology

The project worked with a progressive design to maintain the experimental character of the study but following the four project stages: implementation: familiarisation, communication, participation and multiplications. The progressive design helped to ensure that a variety of paths were explored without focusing on a constant redesign of the project. Additionally, a reflexive approach to methodology was chosen in order to establish a process driven control mechanism which intervened when the project was in danger of drifting beyond anticipation and expertise. Reflexive research contains interpretation and reflection as the two basic characteristics, which the majority of research projects would claim to contain. However, while the research in general incorporates both aspects at some stage in the design and often towards the end in the form of evaluation, the reflective approach locates it at 'the forefront of the research work'. It is based on an understanding that 'all references to empirical data are the 'result of interpretation' *(Alvesson and Sköldberg, 2009:9)*. In this sense, awareness is raised of theoretical assumptions, language and pre-understanding, which was considered as very appropriate when researching international students acting in an international setting. Reflection, the second characteristic, attempts to focus on the inside of the researcher and the research community and pays attention to cultural links and their attached narratives. Considering that the researcher acted in the dual role of participant and researcher in the same investigation it was felt that a critical self—exploration of one's own interpretation not just of the empirical material but also of the process and the construction was necessary while interpreting the interpretations *(Alvesson and Sköldberg, 2009)*. In the research process the following levels of interpretation have been applied: Interaction with the empirical material or occasionally interpretation was carried out during participant observation and during interviewing. In a more systematic approach a second interpretation checked findings against preconceived academic theories such as education theory and creative thinking while critical interpretation related the content of the data and the researcher to wider concepts of society, considering aspects such as power relations and ideology. The final level of interpretation was concerned with the text production of the researcher analysing if, for example, any claims to authority dominated the writing while addressing the selectivity of represented voices.

The project applied a variety of methods and the most suitable were selected in each phase considering practical implications such as student availability and student interests as well as content and methodological concerns. During the foundation and communication stage participants were asked to complete a questionnaire and they participated in two focus group discussions each. The first focus group took place in the virtual environment while the second one was held in the real world seminar room. Participants who choose to complete their assignment in SL were also asked to write a diary. Module feedback forms were added later to the research method since participants were able to comment on those forms about their experience. Additionally, student assessments were analysed, while the practical implementation of the projects also became part of the research process, as were the written assignments. Semi structured interviews were carried out after the participants had undertaken practical work in a 'real world' cultural organisation during a placement or an internship. The researcher kept a diary, which included notes, memos and her own reflections during the whole research process. Participants were observed at all four stages in SL and during the introductory session in the computer labs. The cohort of participants was/is enrolled in a one year MA in Creative Industries Management course *(Events Management, Arts and Heritage Management and Cultural and Creative Industries)* and three consecutive years *(2009-2012)* are/were investigated.

Results

The initial data analysis of ELF shows that immersion into the augmented environment impacted favourably on motivational and emphatic experience of the learners and as one student commented is a fun way to gain experience, while enjoying the freedom to explore and *"being able to go at my own pace"*. The opportunities to participate in building creation *(from design to production)* and filling them with life *(simulation)* are perceived to be a valuable training ground for real life situations, despite the fact that a different form of reality is created. In particular, the exhibition design and its practical application are valued as hands on approaches that show results immediately. The 3D-and 2D-dimensions of art works are experienced in relation to space and location and could be discussed and changed on site within minutes. Students pointed out that the understanding of dimensions helped in real work design processes while gaining confidence in their abilities. As a result more experimental exhibition designs were implemented in both virtual and real world environments. For example, one student organised an exhibition project that showed art works by artists who exclusively produced art work in second life and placed them in the Nordstar gallery. The sculptures were amended in size and proportion to the location built for the exhibition, which would of course have been impossible to achieve in a real world situation. However, later the same student successfully applied her understanding of dimensions *(Which object is suitable for which room? Which art works need more space than others and why?)* while on placement in a London gallery.

Social interaction with the avatar public *(event participants)* proved to be challenging and developed networking skills as well as leadership and marketing competencies As in a real world environment, audience development in Second Life is based on audience research but the catchment area has no geographical boundaries and marketing needs to be directed towards an international audience that might be interested in attending visual arts events. Timing remains one of the most crucial aspects since Second life operates as a real time application. One student working from Cyprus scheduled an exhibition opening for a Saturday afternoon which translated into a Saturday night for the UK. This arrangement excluded most fellow UK students since they were engaged in real life social activities while a number of academics from Northern America joined during their lunch break and some Australian visual arts enthusiasts stayed up late to attend. In this sense, finding the most suitable time for an international audience proved to be challenging. Students paid particular attention to targeting the right group of people for their events. The early projects in particular could not rely on box office data sets for the gallery and therefore tended to rely on word of mouth and friends' networks. However, a less targeted advertising campaign with banners on the main opening page of SL produced a new audience *(newcomers, not normally gallery goers in real life)* that would not initially have been targeted by the students but developed into a reliable group of interested visitors to the gallery.

Although the general experience for the students using SL was encouraging, not all students felt comfortable during the first initial sessions, concluding that their uneasiness might be related to their general dislike of computers. Some students reported that if the first technical barrier *(downloading the software, setting up an avatar)* was overcome with ease they felt enthusiastic to carry on and explore the software further. It is essential to provide initial technical support and foster a open-minded atmosphere among all participants towards 3D MUVE projects to be able to go on to discover their full potential *(Hollins and Robbins, 2009)*.

Overall, the research produced a number of results that could be discussed in much greater detail but which would go beyond the remit of this paper. Therefore I will elaborate in more detail on two outcomes. Both are related to the avatar and its appearance and handling. The first is covered under the banner of 'learning by doing" and relates to the creative process, which at the onset of the research was to a certain extent expected not as a result but as a topic for investigation. A second outcome is discussed here under 'real world methaphor' and was originally treated as a side product and surprised the researcher but consequently has inspired a vivid debate among project participants.

Learning by doing

The software 'Second Life' invites users to browse, to explore locations as learning by trial and error is the main feature of initial investigation and communication. Most of the initial learning takes place independently on an individual level, and many tools in SL have been developed that support these types of leaning. In the project simple orientation tools were created above the gallery space, to be used in the orientation phase. Additionally, students were encouraged to go via the orientation island and explore SL according to their project needs.

As the avatar itself represents a projected model of oneself it could be seen as a key element for successful learning transactions when transferred into an educational space *(Garrison and Anderson: 2003 as quoted in Warburton: 2009)*. In all stages of the ELF project students spent considerable time developing, polishing, changing and experimenting with their Avatar appearance and only when the Avatar was 'looking as intended or met students' satisfaction' did students engage further with SL. Often students felt that the avatar models provided in SL did not reflect their understanding of self-embodiment and they set off instantly to correct their appearance , behavior resembling that of getting ready to go out in front of the mirror in the real world. If initial satisfaction with appearance could not be achieved due to technical difficulties or for other reasons, individual users expressed reactions of suffering and in some instances an impact on physical well-being. Initially, those responses were interpreted as typical teenage/young adult behavior that stresses the importance of self awareness as part of adolescent development but further into the investigation it became clear that reactions went beyond the typical fashion statement and fulfilled a vital function within the learning process.

Harel and Papert. *(1991)* from MIT Media Lab have argued strongly for the positive impact of a self-developed knowledge structure on learning motivation and their ideas about constructionism have been identified as underlying theoretical concepts in a number of research projects related to computer based learning *(Fominykh, M.: 2010, Antonacci and Moderass: 2005)*. In summary, their main argument was that individuals would learn best while making and doing. The avatar, as an embodiment of oneself, could be regarded as the first learning framework that offers a highly individualistic approach where people could design and construct their own appearance. In later stages of the project students extended the work on their own appearance, for example presenting floating and circulating art objects attached to their avatars. One student concluded that the avatar provides 'more freedom to be expressive' in comparison to the real world where appearance is driven by peer group pressure and other cultural norms. Those interventions demonstrated that when a structural framework in the form of an avatar is established, creative thinking is also applied to the personalization of virtual appearance. Here, creativity is understood as a process that produces something new and at the same time creates value while redefining and transforming context *(Bilton and Cumming, 2010)*. If this is translated to the ELF project students produced novel solutions and innovations *(attaching rotating objects to underline their appearance, as mentioned above)*, which they would not be able to do real life situations. Some students went as far as changing their appearance according to the task they undertook and others would try out clothing that they would consider to be culturally inappropriate if worn in real life. For example one girl exchanged her real life head scarf for a mini skirt in SL. Surprisingly, none of the participants purchased outfits, gadgets or other items for sale in SL to wear or use with their avatar. All students opted for using their creativity to alter their appearance rather than their purchasing power. This could be interpreted as a choice that demonstrates an initial creative potential of the participants that then fostered creative thinking further during avatar creation.

Students happily used two contradictory frames of reference as outlined in the creative process. They built a structure expressed by the avatar and redefined themselves in the virtual environment as something new. As a result students established a positive learning experience for themselves based on creative thinking while using the avatar. This initial situation was re-established every time they engaged with the software and resulted in positive and motivational impacts on the learning experience.

Real world metaphor

The second outcome relating to the avatar addresses learning issues but emphasizes primarily skills development rather than the learning process. Previous research has shown that the avatar's direct response to reality is flawed and incomplete, despite the fact that the embodiment may cause a strong sense of being in the virtual world *(Bessiere, 2009)*. Even if the avatar closely resembles the person behind its creation it could hardly be regarded as representative of a real human being. This becomes most obvious when comparing body control of the avatar and the real person. In the real world gaining control of one's body is a result of a lifetime of experiences but in the VW Avatar body movements such as waving, smiling and laughing are realized with one or several mouse/arrow key clicks. As a result, a clear distance is created between real world experience and virtual reality, which the participant needs to negotiate while using the software. Initially, students regarded this as confusing and irritating in the foundation stage of the project. In the participation and creation phase it was hardly mentioned but it became a prominent discussion topic in the multiplication stage, in particular during the evaluation of the students' projects. The transfer including the creation of the distance from real to the virtual dimension was reflected as a potential space that fostered the constant comparison between the two worlds and therefore encouraged students to think in different dimensions. As a result, students' project ideas changed and reflection was used as a tool to describe what they experienced while operating the avatar. Students would no longer be satisfied with simply developing and implementing a project that resembled the real world in the virtual world. Instead they would thematise their experience *(distance between real and virtual)* in their projects, which was triggered by the use of the avatar. For example, one student developed a project that had avatar appearance as its main topic. She invited friends and fellow students to take part in a procession of avatars, who would explore Collyer Island in an evening performance while walking, flying or roller skating from one building to the next. Members of the procession were asked to maintain their position in the float but had to change their appearance in five minute intervals. Therefore, participants came either prepared with several outfits stored in their library in advance or would change spontaneously. In this project the idea was to address the avatar theme in a playful manner but at the same time highlighting the students' own observation of the importance of dressing up in a SL environment.

Additionally, the new project ideas allowed for critical investigations which span from questioning the use of the avatar to an overall criticism of the software programme, addressing the political and philosophical context of SL within the framework of creative industry project management. Students did not address the technical barriers but analysed reflectively the potential and limitations of SL, for example when presenting street art, which has become an established art form in the real world. It was observed that this type of criticism was of a different nature than the start-up frustration often described when SL projects get off the ground and face initial technical difficulties. It could also not be compared to the skepticism that participants with low virtual literacy in particular aired before training in SL was offered. The avatar was identified as a medium that appeared real but at the same time acted as a constant reminder of the distance to real world project management. Surprisingly, the constant comparison from real to virtual and vice versa ensured that reflective and analytical thinking was applied accordingly, resulting in sophisticated approaches to project management while advancing conceptual thinking and incorporating both into the project ideas. The students therefore made a contribution to enhancing the subject field of creative industries project management. In this sense analytical thinking is seen here as a skill that, when applied and used over a longer period of time, becomes absorbed into an individual's general tool kit and knowledge pool and remains accessible for use in real life project management. By continuing to apply conceptual thinking to coursework in the future students achieved higher grades than before their SL exposure. In turn their achievements impacted positively on their aspirations of what they wanted to achieve in higher education and in the working/business environment. Additionally, artists, who acted as one of the main client groups during the project work, noticed that the level of students' reflection resulted in stimulating discussions and overall in a better understanding of their artistic ideas.

Since this outcome was not part of the initial skill set that the researcher envisaged at the beginning of the project, no test was designed to measure analytical thinking at the start of the project. It may in any case be impossible to capture this data. Consequently, it remains in doubt whether the avatar is the only trigger for such a result. Bearing in mind that numerous other social and environmental influences *(such as being exposed to university education)* might have been at work at the same time, these results have to be treated with caution. Additionally, there is a correlation between the reflexive approach of the research and the fostering of analytical skills in the student project population, which may be interpreted as a further trigger for the result described. However, the ELF project's main finding in the area of real life metaphor is the following: Even if the exact extent of the skills development could not be measured there are indications that handling the avatar triggers and supports the development of analytical thinking skills in terms of comparison and self-reflection. Both outcomes, the leaning by doing and the metaphor approach show that learning and skills development is supported by the avatar creation. However, these outcomes are part of a limited investigation in the creative industries project management field and therefore should be considered with care. This research indicates that further theoretical implications in particular relating to risk and challenges of avatar behavior would need to be investigated. For example, Yee and others *(2007)* have summarised concerns relating to the avatar presence as expressed in the 'media effect tradition' in which behavioral scientists measure and analyse the level of individual change that is occurring while switching from virtual to real world and vice versa. As mentioned above the results remain preliminary and it is planned to publish further outcomes in the near future.

Conclusion

This paper presents an extract from the ongoing ELF project, which will be completed in 2012. It focused on avatar design, its workability and on avatar awareness, which were analysed within the framework of reflexive methodology. Two research outcomes were discussed. Firstly, creative avatar applications were analysed under the auspices of 'leaning by doing', which resulted in fostering creativity and personal motivation as part of the independent learning process. Secondly, the enduring comparison between real and virtual worlds as triggered and produced by the avatar supported analytical thinking skills. Although the findings have been presented in this paper as single entities, they remain closely related to their creative industries management context. Creativity and analytical thinking are often regarded as a matching combination and seen as part of the same process despite their profound differences.

Students valued the skills gained as generally applicable with no distinction drawn between the university context and the creative industries business environment. They argued that their aspirations became more ambitious during the project duration and that they exceeded their own expectations within both contexts. Judging by the positive student experience the findings speak for a wider application in project management. However, the reader should bear in mind that a quantifiable measurement of the results remains outstanding. Furthermore, it has to be noted that both outcomes have been discussed in isolation from other results of the ELF project for this paper but they remain as part of the wider identified skill set, which will be taken into consideration in future publications.

Overall, the findings of the 'Experimental learning framework *(ELF)*' project show that Second Life can provide a valuable learning alternative in Creative Industries management training. It offers a close match to real life experiences while operating purely in the virtual world. Additionally, it should be considered that projects can be planned, implemented and evaluated from start to finish with very little impact on the real world environment. Projects require a fraction of the funding of real life projects and could be run from any location in the world that enables internet access. Learners are able to transfer their experiences into non-virtual work applications. As a result, new internationally workable management solutions are tested and developed that will help to define the creative industries management subject field for years to come.

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