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Final Report

The seamless integration of Web3D technologies with university curricula to engage the changing student cohort CG7-488

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USQ UNIVERSITY OF SOUTHERN QUEENSLAND fulfilling lives

CQUniversity AUSTRALIA

web3D CONSORTIUM

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Report Contents

Executive Summary

The increasing tendency of many university students to study at least some courses at a distance limits their opportunities for the interactions fundamental to learning. Online learning can assist but relies heavily on text, which is limiting for some students. The popularity of computer games, especially among the younger students, and the emergence of networked games and game-like virtual worlds offers opportunities for enhanced interaction in educational applications. For virtual worlds to be widely adopted in higher education it is desirable to have approaches to design and development that are responsive to needs and limited in their resource requirements. Ideally it should be possible for academics without technical expertise to adapt virtual worlds to support their teaching needs.

This project identified Web3D, a technology that is based on the X3D standards and which presents 3D virtual worlds within common web browsers, as an approach worth exploring for educational application. The broad goals of the project were to produce exemplars of Web3D for educational use, together with development tools and associated resources to support non-technical academic adopters, and to promote an Australian community of practice to support broader adoption of Web3D in education.

During the first year of the project exemplar applications were developed and tested. The Web3D technology was found to be still in a relatively early stage of development in which the application of standards did not ensure reliable operation in different environments. Moreover, *ab initio* development of virtual worlds and associated tools proved to be more demanding of resources than anticipated and was judged unlikely in the near future to result in systems that non-technical academics could use with confidence.

In the second year the emphasis moved to assisting academics to plan and implement teaching in existing virtual worlds that provided relatively easy to use tools for customizing an environment. A project officer worked with participating academics to support the teaching of significant elements of courses within Second Life™. This approach was more successful in producing examples of good practice that could be shared with and emulated by other academics. Trials were also conducted with ExitReality™, a new Australian technology that presents virtual worlds in a web browser.

Critical factors in the success of the project included providing secure access to networked computers with the necessary capability; negotiating the complexity of working across education, design of virtual worlds, and technical requirements; and supporting participants with professional development in the technology and appropriate pedagogy for the new environments. Major challenges encountered included working with experimental technologies that are evolving rapidly and deploying new networked applications on secure university networks.

The project has prepared the way for future expansion in the use of virtual worlds for teaching at USQ and has contributed to the emergence of a national network of tertiary educators interested in the educational applications of virtual worlds.

Background to the Project

Students entering Australian universities, whether direct from schooling or returning to study for career change or advancement, are increasingly not well matched to the traditional regime of lectures and tutorials. This change is not a simple one and reflects the influence of multiple factors to which this project responds.

One factor to which the project responds is the increasing tendency of students to prefer to access at least some aspects of their study in distance mode. Between 1989 and 2002, the proportion of Australians aged between 20 and 24 who were enrolled in higher education increased from 10% to 19% (DEST, 2005). Directly comparable data for years beyond 2005 were not available but between 2001 and 2009 the proportion of 20 to 24 year old Australians enrolled in study for a qualification increased from 33.8% to 38.8% (ABS, 2009). These data suggest participation by a broader segment of the population than previously. Many of the students, especially those from lower socio-economic groups and those returning to study have a variety of commitments, to employment or family, that affect their capacity to participate in conventional classes on campus. The extent to which Australian university students are engaged in paid employment during semester is considerable. According to a Universities Australia report (James, Bexley, Devlin, & Marginson, 2007), in 2006 70% were working an average of almost 15 hours per week, 15% were working more than 20 hours per week, and almost 5% reported working full-time. As a consequence many students find it difficult to attend scheduled classes on campus and need flexible educational opportunities that allow them to balance study, family and work commitments to meet individual needs. Even for those students who live close enough to campus to attend classes, at least some features of distance education are attractive because of the flexibility they afford.

Because interaction is widely believed to be fundamental to learning (Ertmer & Newby, 1993), learning at a distance presents particular challenges. Distance education, especially in its earlier manifestations that operated by correspondence, was often considered as “second rate” because of the limitations it placed on pedagogic interaction (Koul, 2006). The challenge of interaction in distance education has been discussed in terms of a theory of transactional distance (Moore, 1993), in which distance is seen as not merely geographic separation, but a pedagogical concept addressing the psychological and communications space that separates learner and teacher. Moore argued that new technologies could mitigate the effects of transactional distance by permitting forms of interaction, such as computer-mediated communication, that had previously been impossible for learners at a geographical distance. However, although the written dialogue characteristic of most online education works well for some learners, depending to some extent on personality type (Lin, Cranton, & Bridglall, 2005), learning style and educational purpose, it lacks many of the cues associated with face-to-face communication. Such telepresence is a “form of disembodied presence” (Mason, 1995, as cited in Shin, 2002) and some learners find the reliance on text limiting. Other research has identified lack of authenticity and presence as issues for online learning (Land & Bayne, 2006). Using online learning environments in ways that offer more than text for communication seems to have potential for reducing transactional distance and encouraging interactions that support learning.

A second factor to which the project responds is the widespread popularity of computer games among students entering university from school. These students typically have life experiences that differentiate them from previous generations (Oblinger & Oblinger, 2005). The world in which they have grown up is highly connected. They have been described as “IT savvy”, “digitally literate”, “connected”, and “always on”, and their learning preferences tend to be for active participation, working in teams with peers, and accessing information as it is needed. Some have gone so far as to suggest that these “digital natives” think differently because environmental influences, including extensive experience with computer games, have caused their brains to be wired differently (Prensky, 2001). Whether or not this is the nature of the difference, education in the “information age” requires strategies other than delivery of information (Herrington, Reeves, & Oliver, 2005) and there is a need

to develop authentic online learning experiences that respond to characteristics of learner, task, and technology (Herrington, Reeves, & Oliver, 2006). Such environments often share features in common with computer games and simulations, which have been demonstrated to be effective vehicles for professional learning (Ertmer et al., 2003; Kiegaldie & White, 2006) and have been suggested as a prime means of developing education in ways that will help students to deal more effectively with the real world (Shaffer, 2006). The observation that significant skills of leadership and management can be learned in game environments such as *World of Warcraft*, not as an explicit objective of the game but as a corollary of the activities required for success (Brown, 2006), raises the questions of whether and how games can be designed with learning as a primary aim.

These factors, the inclination of students to engage in at least some study through virtual attendance and the popularity of computer games, have informed the development of this project. Multi-user virtual environments (MUVEs) or 3D virtual worlds have many characteristics similar to popular massively multiplayer online role-playing games (MMORPGs) such as *World of Warcraft* but lack the explicit goals. Because they typically represent participants using avatars with human appearance, both MUVEs and 3D games have the potential to reduce the sense of disembodiment experienced by some learners in text-based online environments. Early versions of such systems were limited to text chat for communication but current versions support voice conversation and streaming of media from outside the MUVE. Such 3D spaces have been found to enhance social presence (Hauber, Regenbrecht, Hills, Cockburn, & Billinghurst, 2005; Salinäs, 2005) in ways that should reduce transactional distance and promote learning.

Designing educational games and simulations requires knowledge and skills in both educational design and games design (Agostinho, Meek, & Herrington, 2005; Chambers & Stacey, 2005) and the design of 3D virtual worlds will require a comparable combination of capabilities. Because few individuals can both produce an educational design and manifest the artistic and technical skills needed for its implementation, such projects are commonly undertaken by teams, which bring together the necessary skills but increase the complexity, time, and resources required for development. Professional quality games and simulations are expensive to create. If these technologies are to be adopted for mainstream use in universities it will be necessary to evolve approaches to design and development that minimize the resource requirements.

Gilbert (2004) identified two threshold factors limiting uptake of new technologies in education. The first was the problem of limited resources as described in the previous paragraph. The second was common reluctance among teachers to make major changes to already successful practices. Gilbert argued that changes that seemed less major would be more likely to be acceptable and would also require fewer resources for implementation. From this thinking grew the idea of a Low-Threshold Application (LTA), which is a "teaching-learning application of information technology that is reliable, accessible, easy to learn, non-intimidating, and incrementally inexpensive" (Gilbert, 2004, p. 49).

The role of interaction in learning, especially in distance education, the potential of 3D virtual environments and games for addressing related issues, and the significance of low-threshold applications as a mechanism for change have been discussed in greater detail in publications associated with the project (Peter R Albion, 2008a, 2008b; Peter Robert Albion, 2009; de Byl, 2008, 2009; de Byl & Taylor, 2007).

Project goals

Against this background, the broad goal of the project was to increase knowledge about the usability, usefulness, and effectiveness of 3D immersive environments within the higher education sector. This goal addressed two of the priorities of the Australian Learning and Teaching Council:

- Priority 2 – Strategic approaches to learning and teaching that address the increasing diversity of the student body, and

- Priority 4 – Innovation in learning and teaching, particularly in relation to the role of new technologies.

The project application identified Web3D (http://www.web3d.org/) as a promising technology that had the advantage over other 3D virtual environments of operating seamlessly with existing infrastructure for web access used by students and staff at universities and elsewhere, including at home and other common locations for study. At that time Web3D was developing a high profile in Europe and the U.S.A, but its uptake was slower in Australia. Moreover, there were no known frameworks or strategies in place to seamlessly integrate Web3D technologies with e-Learning environments. The project was intended to develop and showcase such an innovation as an Australian higher-education initiative. USQ was already active in such development through the internally funded ALIVE (Advanced Learning and Immersive Virtual Environments) project.

More specifically, the project aimed to produce the following outcomes:

- a suite of exemplars, open source rapid-development Web3D e-Learning focused tools, guidelines and insights for the successful adoption of Web3D technologies for mainstream use within curricula, and
- an Australian community of practice for Web3D e-Learning training support and research as an annex to the international Web3D consortium, a nonprofit organization that develops and maintains the X3D standard (http://web3d.org).

These outcomes were expected to empower educators to create their own games, simulations and immersive 3D environments through the use of Web3D technologies and enhance student engagement through authentic learning activities within discipline curricula.

Approach and Methodology

The project was planned to involve two regional universities, USQ and CQU, both with strong commitments to distance education, in activities designed to address needs of students, staff and the broader higher education community. The underlying framework was based on an action research model in which individual academics and course teams were to design, create and evaluate teaching and learning elements using Web3D technologies, with support from teams of education and technology specialists at each campus and the broader Web3D community of practice. Resources were to be developed through three interlinking foci:

Student resources were to be developed through a two-stage process. The first stage was to involve a small group of early adopter teaching staff recruited from a variety of discipline areas following a series of presentations by the project leader. Each participant in the first stage was to work with the development team to create an exemplar Web3D element for use in his or her teaching while sharing in a mutually supportive community of practice. In the second stage those participants would then be available to provide mentoring to the second group of participants as they worked on developing their own Web3D elements using the tools and techniques refined in the first round.

Staff resources, intended to be easy-to-use rapid-development tools and techniques (LTAs), were to be produced by a team of developers working side by side with the staff participants. In the first round the developers were to assist the early adopters to produce Web3D elements using existing Web3D development tools. Because the existing tools had been previously evaluated as requiring considerable technical expertise for use, the second stage was to include building tools that would be more accessible to teachers without specific expertise in development of 3D environments.

Community resources were to be delivered through an interactive website to be established for the purpose. It was expected to engage project participants, the Web3D community, and other interested persons in an ongoing conversation about the educational

application of Web3D technologies. It was also to provide a central location through which materials, tools and other resources developed through the project could be shared.

Appendix A presents the original proposed timeline and deliverables for the project.

Year 1

Progress toward goals

Activity in the first year of the project commenced according to the plan outlined in Appendix A with four areas of development activity: Web3D exemplars, Web3D tools and resources, support for Web3D adoption, and Web3D community of practice.

Web3D exemplars

Following a staff forum and seminar at USQ, nine staff members were recruited as early adopters to work on the creation of Web3D learning and teaching applications as follows:

- *Escape Alive*: A fire evacuation training simulation, led by the USQ workplace safety manager
- *Exoplanet*: A game aimed at teaching students how to assess the characteristics of planets for safe habitation by humans, led by a physics/astronomy academic
- *Facilitate This*: A 3D situation game to teach group facilitation skills, led by a psychology academic
- Forensic Accounting: An online crime scene investigation scenario focusing on accountancy crimes, led by an accounting academic
- Mathematics Online Social Community: An online 3D immersive world in which IT students can use their mathematics skills to build activities in the world, led by a mathematics academic
- Visualisation of Foundation Computing Concepts: Embedded 3D models of computer components inside web pages led by an information systems academic
- Situational Judgment Tests: A simulation to add realism to the SJTs by integrating visual cues that do not exist in traditional "pen and paper" SJTs, led by an information architect
- Visualisation of 3D Modelling and Animation Concepts for Arts Students, led by an arts academic
- Medicalc: A simulation game that teaches nursing students how to calculate medicines, led by a nursing academic.

During the first year of the project operation to September 2008 the first three exemplars, *Escape Alive*, *Exoplanet*, and *Facilitate This* were developed to the point where they were available for testing by the academics who specified their design. The following additional simple Web3D applications were developed as early examples and made available on the project website to demonstrate the technology:

- Interactive 3D model of skeleton with labeled components,
- Solar System visualization, and
- ALIVE Classmate - an online virtual classroom environment.

The accounting academic interested in the design of the forensic accounting application continued to be interested in the project but the specification and development of the application was delayed by commitments to other work. Development of the remaining five exemplars did not proceed for reasons including departure from USQ of some of the participants and greater than anticipated demands on resources for development of the exemplars that were under active development.

In addition, the team at CQUni developed exemplars based on the use of machinima (video recordings of activities in 3D virtual worlds) to record scenarios and activities in 3D environments.

Web3D tools and resources

Alongside the development of the exemplars described above, the programming team worked on development of the ALIVE DXEditor which was intended to make it possible for relatively inexperienced users, including teaching academics, to build custom 3D environments using a library of objects varying from primitive solids to complex elements of landscapes and buildings. Experience gained in developing the exemplars guided development of the editor. Adherence to emerging standards for 3D objects was intended to permit transferability among different 3D environments and tests conducted as part of the development process confirmed that transferability was possible. The editor was made available for download from the project web site.

During the same period the team at CQUni developed experience in the tools and processes of machinima production by undertaking development of exemplars for use in courses (Nola Muldoon, Jones, Kofoed, & Beer, 2008; Nona Muldoon & Kofoed, 2009).

Support for Web3D adoption

Through their work on developing the exemplars, project staff gained experience in supporting development of 3D teaching materials from conceptualisation by academics, through specification, to implementation. As this experience accrued it informed successive phases in the development of tools and processes to enable teaching staff to develop 3D teaching materials more independently. Preliminary documentation of approaches to design and development of the exemplars produced at USQ was loaded on the project web site, together with video demonstrations of the tools in action.

Members of the project team tested a variety of tools for creating Web3D content and completed a report on the use of Web3D technologies which was made available on the project web site together with links to relevant literature. These investigations informed work on development of the exemplars.

Similarly the CQUni team documented the development of techniques for producing machinima in Second Life.

Web3D community of practice

A Web3D Exchange site (http://web3dexchange.org) was established using an open source package that supported member signup and content sharing using a wiki and blogs. Following a security breach, the interactive elements were locked and alternatives provided using blog software and a Google group with a set of static pages that enabled access to project resources. Materials made available on the site included descriptions of exemplars planned for development, a survey of Web3D tools and resources, downloads of ALIVE Classmate and the ALIVE DXEditor.

The CQUni team used a wiki (http://cddu.cqu.edu.au/index.php/Web3D_Exchange_Project), associated blogs and RSS feeds to support the CQUni community working on the project in ways consistent with other work by the CQUni group.

Challenges encountered

Although the project made substantial progress during the first year of operation there were challenges that resulted in delays and, ultimately, reappraisal of directions.

X3D Standard

Although the X3D standard is intended to be cross-platform and interoperable, the programming team found that different interpretations of the standard could cause a scene

that functioned on one system to fail on another. Moreover, the best efforts of the team were unable to locate an X3D compatible browser plugin for MacOS and X3D operation in Windows using MacOS virtualisation software was found to be unreliable. Development adhered as closely as possible to the X3D standard and tests on the transfer of assets into the Wonderland (https://lg3d-wonderland.dev.java.net/) and ExitReality (http://www.exitreality.com/) environments demonstrated the value of that approach. However, although X3D was adequate for static 3D scenes it proved to be unsuitable for more complex exemplars such as event driven games.

Project Scope

The initial project scope defined Web3D as a real-time and possibly networked 3D scene or environment embedded within a web page and viewable within a web-browser. The technical limitations of the X3D standard and the limited availability of X3D browser plugins substantially reduced the attractiveness of X3D as a standard around which to develop. It also made some of the exemplar ideas impossible to implement using existing X3D development tools.

The CQUni team defined Web3D more broadly to mean virtually any 3D derived material that could be produced to fulfill the educational needs of courses within resource constraints. Second Life was adopted as the main platform because of the relative maturity (compared to open source platforms), size of the user community and relative ease of manipulation. Efforts focused on embedding Second Life as another tool within the tool set of CQUni's Learning and Teaching support group, which could be drawn upon to help fulfill educational requirements. Projects included use of machinima to produce video segments for presentation as stimuli in web-based course materials and creation of a social space to support communication by Social Work distance education students.

The USQ team broadened the definition of Web3D to include networked 3D content either embedded within a browser or not. This approach minimised the potential for problems caused by interaction with the browser environment. The three completed exemplars, *Escape Alive*, *Exoplanet*, and *Facilitate This*, were developed as free-standing programs.

Animated Avatars

Static 3D objects were relatively simple to create. Characters or avatars were found to be considerably more complex because of the need to animate such objects. This added to the complexity of development and slowed progress on exemplars requiring such animation.

Security of Web3D Exchange site

Two versions of the proposed Web3D Exchange site were developed using open source content management systems (PHPWiki and Joomla). Following a security breach, the interactive features of the site were disabled and alternative arrangements were established using some static pages, a blog site and a Google group. With the release of the ALTC Exchange in the latter part of 2008 an attempt was to be made to establish that as the site for development of a Web3D community within Australian higher education.

Changes in project personnel

Early in 2008 the project leader, Dr Penny de Byl, accepted a position at Breda University of Applied Sciences, Netherlands, and departed USQ in June 2008. With agreement from ALTC, Dr Peter Albion became project leader. The Web3D programmers left USQ when their contracts finished late in 2008 but were able to finalise work on the three major exemplars. Dr Janet Taylor also departed USQ at the end of 2008 to take up a position at Southern Cross University.

Between April 2007, when the project was funded, and mid-2008, the CQUni Division of Learning and Teaching Services went through an extended period of restructure that limited work on the project. Late in 2008 David Jones changed position and was no longer able to engage in the project. CQUni did not participate in the project beyond that time.

Lessons learned

The experience of the first year of the project informed the report that was submitted at that point and decisions about directions to be taken in the second year of the project.

Lack of existing easy-to-use tools

Although there are many tools available for creating 3D objects, they require technical skills beyond those possessed by most academics. Creating high quality 3D objects requires the use of professional tools such as Maya, 3D Studio Max or Blender 3D, all of which require considerable practice to develop the skills necessary for creating original 3D content. Experience in Second Life suggests that one solution to this is available through systems with an existing large community of users who are producing and sharing resources.

Cross-Over of exemplar requirements

Several of the proposed exemplars had common elements in the virtual environments they envisaged. The ability to reuse elements, with or without relatively minor customisation, can reduce the development work which requires skilled technical staff and enable the development of libraries of elements that can be used in future developments. Work later in the project demonstrated that it is possible to take assets developed in this project and transfer them into other virtual environments such as Wonderland or ExitReality. Over time it should be possible to develop libraries of generic elements that can be used directly or adapted for new learning environments. As these become available it should be possible for academics wishing to create custom 3D environments to select many of the necessary components “off the shelf”.

Design of educational games challenges individual skill sets

Relatively few educators are game players. As a consequence they find it challenging to conceptualise the design of games to support learning in their discipline areas. Similarly, team members familiar with games, often as a result of extensive playing experience, may not be able to articulate principles of game design, and are generally not well versed in educational design. Successful development of educational games requires bringing together varied expertise across at least the domains of content, educational design, game design, graphics, and programming. Recruiting team members with one or more of the necessary skill sets and facilitating communication among them is essential for success.

Start-stop-start part-time development is inefficient

Complex activities such as design and development of games require immersion in the activity. Part-time developers working in short bursts require time to become immersed each time they resume work. Arranging work to reduce interruptions would reduce the loss of productivity caused by the need to recall details of the task before progressing.

Development trends appear to be away from stand-alone objects

The worldwide direction for the use of 3D appears to be moving rapidly toward massively multiuser online environments rather than stand alone learning objects. These environments allow objects to be built and shared within them in a rich immersive environment rather than in isolation from their context. At the same time the pace at which new environments with learning potential are emerging makes it important to develop assets that can be conveniently transferred for reuse in different environments.

Platform specific developments exclude significant groups of users

Platform specific solutions deny access to many teachers and students. It is important to ensure that as many users as possible can access learning environments and materials. That includes users of different platforms such as Windows, Macintosh and Linux and systems that may be up to 3 or 4 years old. The use of development environments that depend upon advanced hardware configurations and/or specific operating systems is problematic. Clients of some 3D environments have hardware requirements that exceed the capabilities of the computers available to some students at home and of the computers in university computer labs. Similarly, organizational networks may not support some 3D environments due to security and financial (cost of network traffic) reasons.

Significance of location of an innovation within the host institution

At USQ the project evolved from the skills and interests of an individual academic, the original project leader, teaching and working in a Faculty. She was able to bring together a small team who shared at least an interest in the potential of the innovation and to attract institutional support for some preliminary work and for the grant application. However, the design and implementation of the innovation continued to be largely driven by that singular vision which made the project vulnerable to the loss of the individual and peripheral to the major learning and teaching development work at USQ. Her departure from USQ required a change of project leader and, linked with the challenges described above, resulted in changes in the detail of the project direction, which were approved by ALTC. Subsequently USQ, convinced at senior levels of the potential value of 3D environments as learning spaces, retained a specialist in the area of online learning in 3D environments who has worked on developing an institutional strategy for wider use of 3D immersive learning environments across the university and as part-time project officer to support this project.

Refocusing for Phase 2

The overall aims of the project were to

- develop exemplars, tools and processes for the adoption of Web3D technologies for mainstream use by teaching academics, and
- create an Australian community of practice for Web3D e-Learning and research.

At the end of the first year of operation, these aims remained current and significant but based on what had been learned the specific approaches to achieving them required adjustment.

After a year of development effort it had become apparent that the X3D standards and tools were at an early stage of development. Despite successful trials with transferring project assets into a different 3D environment, development effort in the project was frustrated more than once by difficulties with cross-platform interoperability, especially when attempting to do more than model static 3D scenes. Although the standards may offer a solution in the longer term, it became apparent that in the shorter term it would be more productive to work with existing environments, such as Second Life, which already offer comparatively easy development of 3D environments and a growing community of practice among interested educators.

As the team worked on specifying and building the exemplars it became apparent that non-technical academics would require support across all aspects of development of 3D environments. Academics unfamiliar with games and simulations needed support with conceptualizing activities that would be both educationally valuable and feasible in the 3D environment. Until more academics could develop the relevant knowledge and skills, the most practical solution would be for them to work with somebody with solid background in both pedagogy and 3D environments. Although the work on development of the ALIVE DXEditor had been intended to produce a tool that could be used by non-technical academics, after a year of work the tool still required appreciable time and effort to learn

and was not sufficiently simple to operate. Actually building and deploying activities was likely to be best supported by providing existing environments with assets that could be selected and used from a library with minimal or simple adaptation supported with appropriate video and text based cases.

In light of the experience from the first year of the project as described above, the first year report to ALTC proposed that the development emphasis shift away from *ab initio* development of objects based on the X3D standard and toward working with existing immersive environments such as Second Life. Experience in Second Life was to inform development of a 'library' of in-world contexts and tools that could be used by academics as the basis for designing and implementing learning activities in Second Life. Additional emphasis was to be given to providing sustainable support to academics wishing to design and implement 3D activities for learning. The proposed support included some direct training but, in order to enhance sustainability and foster similar developments within a wider community of practice, heuristics and other documentation were to be developed to facilitate independent exploration of possibilities by interested academics. This change was reflected in an increased budget allocation for project management and research assistance. The role of the proposed project officer was to work with academics to ensure successful exemplars with documentation of processes for guidance of future users and to promote wider interest in the project through developing a community of interest.

Existence of the ALTC Exchange web site made the development of a separate community web site less necessary and probably less desirable for potential users from the Australian higher education community. It was proposed to focus efforts to develop a user community on the ALTC Exchange while retaining the possibility of project web sites for direct distribution of some resources.

Year 2

Activity in Second Life™

By the end of the first year, the original project team had been substantially reduced. The project leader had left USQ and a second member of the USQ team was preparing to leave. The team member at CQU was in a period of transition from one position to another following institutional restructuring and CQU was unable to continue effective participation in the project. Links with the Web3D consortium had been maintained through the original project leader and were no longer relevant as ongoing review of progress indicated that progress in Web3D development was unlikely to achieve the original intent of the project.

Early in the second year of the project a project officer with substantial experience of education in 3D virtual worlds, primarily Second Life, was appointed. The focus of the project shifted from development of custom applications and tools to the educational applications of publicly accessible virtual worlds. The primary effort was directed toward working with Second Life, which is probably the most widely known 3D virtual environment, offers extensive options for customizing spaces, and has an already robust and growing community of educational users sharing their experience. Second Life does present some challenges with identity (avatars have a restricted choice of names that typically do not correspond to the real world identities of their owners even though it is possible to include them), ensuring control over who is present in a class space (especially if open access to the public is maintained), and the network speed and data limits required for convenient and continuing use. Despite these limitations, because Second Life offers free basic access for users across Windows, MacOS and Linux, and comparatively advanced capabilities, it was considered the best available alternative.

The process was a four-phase action research cycle of Explore, Plan, Act, and Reflect.

Explore: This phase began with a presentation to raise awareness among staff and a call for volunteers. Commitment to working with the project was obtained from staff in two

areas, the Criminal Law B course within the School of Law and the English Language and Culture Program (ELCP), which offers short programs to overseas students throughout the year.

The project officer began work on building an internal wiki of resources about virtual worlds in education. Based on these materials both groups of volunteers were offered demonstrations of the possible uses of Second Life that might be relevant for their use and participated in hands on training in the operation of the Second Life environment.

Plan: An important first step was matching the needs of the subject to the affordances of the virtual environment. Planning was based on the framework developed by the project officer which identifies 5+1 roles for virtual worlds in education – 1 = Location, 2 = Content, 3 = Context, 4 = Community, 5 = Materials, and (+1) combinations of these (Figure 1).

Figure 1: Framework for Educational Applications in Virtual Worlds

The project officer worked with each of the course leaders to identify a related problem, issue or opportunity for which the use of a virtual world might offer some advantage.

In the case of **Criminal Law** the selected issue was the lack of lifelike role-play opportunities for distance education students as compared to on-campus students who have access to an on-campus moot court room for advocacy practice. Off-campus students recorded court presentations for submission for assessment. On-campus students had the benefit of a fully interactive experience with questioning from a "judge" played by the lecturer in the role-play situation. This made for a more realistic experience and created a more authentic assessment that allowed the lecturer to surface the student's understanding of the law through questioning. The course leader saw potential for role-play in a virtual world to offer off-campus students more of the opportunities available to those studying on-campus.

For the **ELCP**, a lack of opportunities to use spoken business English in a range of lifelike contexts is an issue for students who are on-campus in Australia for only short periods of time. Opportunities to practise their English on their return to their home countries are also severely limited. Staff wanted to create a range of typical business role-play scenarios including reception desk, meeting room, tour desk, multimedia presentation, office desk, use of office machines such as computer, laptop, photocopier and data projector. They also wanted practice areas for students to prepare in pairs for their role-plays.

Act: In this phase the project officer worked with and supported the course leaders as they specified the virtual environments, developed the environments and teaching resources, and worked through one or more cycles of activity with learners.

For the **Criminal Law** case, the first stage involved identifying and working with contract third party content creators to make a virtual courtroom on USQ Island in Second Life. The facility was built to resemble as much as possible the Toowoomba Courthouse (Figure 2).

Contract third party content creators were also engaged to make costumes of appropriate court attire for use by avatars engaging in role-play. Members of the course team were provided with training by the project officer in the use of the Second Life environment and specific features of the court house. The course team, in turn, conducted practice sessions for their students.

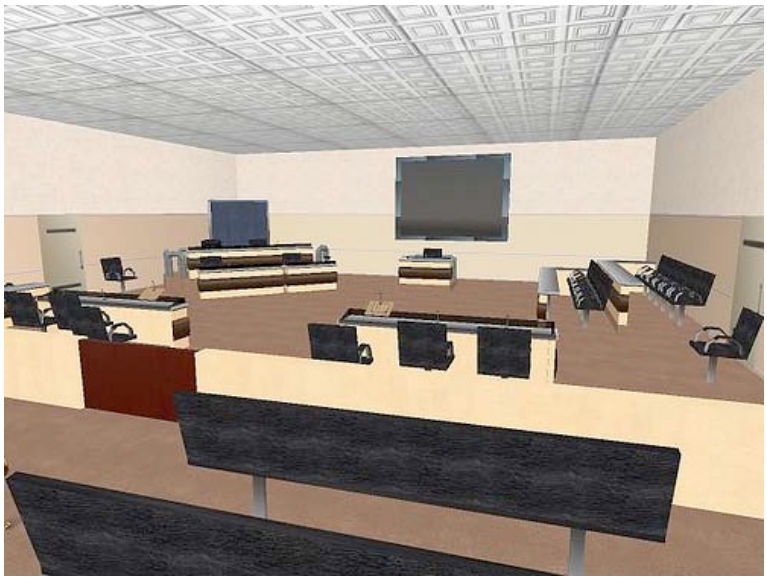

Figure 2: Virtual Moot Court in Second Life

Because all students using the virtual moot court would require orientation to the specific environment and most were expected to have limited prior experience of Second Life, it was important to provide for effective orientation. The course leader prepared a short script for filming of a video (machinima) inside Second Life. Working from the script, the project officer created the raw video footage, which was then used by on-campus media production staff to create a final product that could be incorporated with other orientation material within the normal class online environment using the Moodle space developed for the course.

To ensure that students entering the Second Life environment had a positive initial experience it was decided to construct a private student orientation area within the USQ Second Life environment rather than take the risk of students being exposed to uncomfortable experiences in the Second Life public orientation areas. Activities similar to those used in the general Second Life orientation area were developed in the USQ space so that students could practise movement, communication, and camera control using artefacts that would appear in the USQ Second Life space. This also meant that students were already on the virtual USQ campus rather than having to find the USQ campus, thereby reducing the distraction factor.

The staff of the **English Language and Culture Program** (ELCP) worked with on-campus students visiting for immersion English language learning. They took a structured approach to providing orientation for students to this very new online environment. This was a step-by-step approach to learning the new language and the skills needed to use the virtual

world and its content. An important component of this process was making explicit the difference between virtual worlds for learning and playing computer games. Making this distinction clear was necessary for keeping the students on task in the rich and distracting virtual environment.

They followed the formal, structured orientation with structured role-play lessons that engaged the students in lifelike situations and created opportunities to practise the language in the context of an office environment. Students were introduced to new vocabulary, planned a role-play, practised these in pairs in private practice spaces and then completed role plays in the office building (Figure 3) in context.

Figure 3: Second Life Office Space for Teaching Business English in the ELCP

Reflect: A key component of the action research was regular reflection in meetings with the staff involved in each case. In addition to periodic meetings with the teams there was informal dialogue with the project officer by telephone, email and in regular meetings in the virtual world to share links to resources, discuss ideas, and seek solutions to problems as they arose. These “in-world” meetings provided essential practice for the staff and built their confidence. Throughout the periods during which the courses ran, plans and materials were modified in response to teacher skill development, student responses, and teachers’ needs.

Staff working in the Criminal Law course found that *office hours* held in the virtual world were very effective as a method of communicating with students. One student found the virtual world sufficiently effective that he initiated a study group for the course using the Second Life space outside of normal class hours. The group was subsequently offered more widely to Law students for use as a support group. The course leader saw this as a very positive outcome for the support of distance learners and indicative of the comfort and interest level of the students in the use of the virtual world. The fact that students can be contributors not merely passive consumers was seen as a strength of the virtual environment.

As each course was completed, the project officer conducted interviews with the course teams to capture their experience more fully. Participating staff commented that it had taken a lot of time for them to come to terms with the new and innovative way of teaching using 3D environments. All said they would continue to use virtual worlds as long as students were able to get quality access on campus. They felt that, although it had taken a lot of time for them to master the environment, it did not take as long for their students. They also felt that the gains to the learning were valuable enough that not only would they continue to use virtual worlds but they wanted to get more people in their faculties to use them and expand the student use in future courses. If it were to be mainstreamed both said adequate training of staff was extremely important. This needed to be about more than

the operation of the computers and software. It needed to address the changes in teaching practices, assessment techniques, and classroom management required in 3D virtual worlds.

Avatar appearance was also a focus for both staff and students. In both cases having ready access to appropriate attire for the role-plays would have been easier with prepared materials available on the USQ Island. Both staff and students wanted to personalize their avatars. These materials will be added to the orientation area to expedite this process.

Activity in ExitReality™

Around the time that the project officer was appointed in the second half of 2008, she became aware of the emergence of ExitReality™ (http://www.exitreality.com/), an Australian technology that enables any web page to be rendered in a 3D format that can be viewed in a browser after downloading a relatively lightweight (4 MB) plugin. In addition to the generic view, the technology supports the creation of customized spaces that display the content of a web page over a background selected by the page owner with capacity to add and place a variety of 3D objects selected from a library.

Although ExitReality does not (at least at this early stage in its development) offer the same degree of customization and scripting of objects that is possible in Second Life, it is standards-based and offers some of the other advantages that were anticipated for Web3D such as operating within a browser with relatively modest demands on bandwidth. The technology is in a relatively early stage of development and only the developers can effect the addition of objects with new functionality, which can then be accessed by the page owner setting parameters associated with the objects. However, it is possible to import and place objects developed in other standards compliant environments such as that used in the first year of the Web3D project. Features such as streaming media and audio communication were being added at the time that the technology was considered for use in the project.

In order to test the capability of ExitReality as a potential platform for educational applications the project officer worked with members of the employment assistance group at USQ and the ExitReality development team to construct a demonstration environment that could be used for an online Graduate Careers Market in April-May 2009. This project built on work that the project officer had undertaken for the equivalent event in 2008 using Second Life. As in 2008, the 2009 event ran in parallel with an on-campus careers market and was supported by many of the same potential employers who provided content for online exhibits as well as attending the on-campus event.

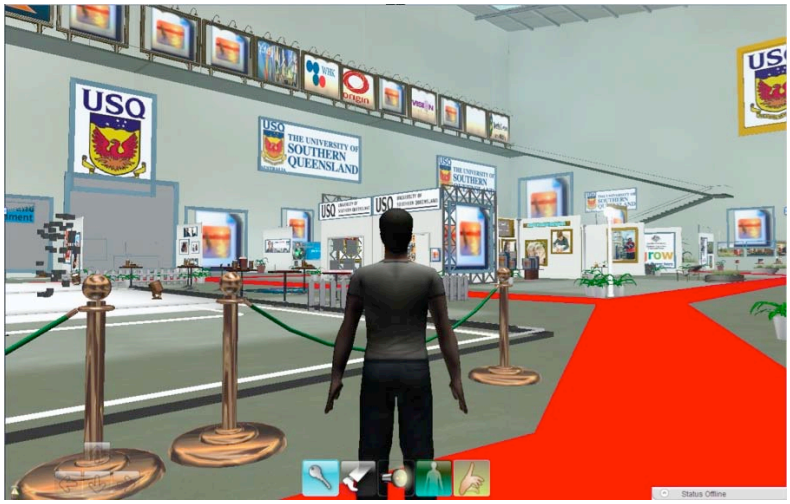

Figure 4: 2009 Virtual Careers Market (ExitReality)

Construction of the environment involved the development of a large interior space that formed an exhibition hall with stairs allowing avatars to access a raised deck (Figure 4). Exhibits were developed from materials provided by exhibitors and some customization of objects facilitated presentation of content with links to exhibitor web sites and streamed video. The eCareers fair was advertised alongside the on-campus event with a focus on attracting visits from students studying by distance. Over the week during which the eCareers fair operated it recorded 2402 hits of which 33% entered beyond the first page. ExitReality logged 480 unique users and 793 total visits, indicating a level of repeat visits. This compared with 1000 visitors to the on-campus Careers market and provided participating employers with a 50% increase in exposure.

The success of the virtual careers fair has led to the international careers fair conducted by a commercial organization for Australian higher education institutions being offered in ExitReality for the first time in 2010.

Progress toward goals

In its second year the project shifted focus from the original emphasis on Web3D (that is, 3D content presented within a web browser) to working with existing 3D environments that offered promise for relatively easy customization by educators. This was thought to be a more realistic option than continuing the effort to build environments from start to finish. However, the broad goals of the project remained as they were and it is appropriate to consider the outcomes of the second year in relation to those broad areas.

Exemplars

Three exemplars of 3D virtual environments, purpose-built in consultation with the principal users, were constructed and tested with students and/or other visitors. These were:

- Virtual Moot Court for Criminal Law class (Second Life),
- Virtual office environment for ELCP Business English class (Second Life), and
- Virtual Career Fair (ExitReality).

All three exemplars enjoyed success, which was evidenced in a high degree of acceptance by users. Both the course teams and end users of the respective spaces reported positive experiences in spaces that worked effectively for their intended purposes.

Some planning was also undertaken on the forensic accounting simulation that had been listed among the exemplars for development in the first year of the project. Work progressed as far as planning some buildings and other artefacts that would be required in the simulation and mapping out the logic of the scenario. However, realization of the scenario as envisaged by the participating academic would have required complex animation of avatars and programming that would have bordered on artificial intelligence. It was decided that simulation was beyond the resources of the project.

Tools and resources

Although the major focus of activity in the second year moved to Second Life, ExitReality (http://www.exitreality.com/) was investigated as a newly emerging environment with some potential to fulfill the original project goal of 3D content in a standard web browser (Web3D). Assets developed to X3D standards in the first year were successfully imported into the ExitReality library, making them potentially available to other users. Existing objects were positioned in the environment and some work was undertaken to design interactive objects that were constructed by the ExitReality developers and later used in the virtual Career Fair.

Beyond the exemplars of 3D virtual worlds and the various objects created and/or imported for use in those spaces, the activities produced preliminary guidelines for planning and implementing virtual worlds in classes. These included the framework described above (Figure 1) and guidelines for effective approaches to orienting staff and students in virtual

environments and for planning learning activities. Machinima (video clips filmed in Second Life) and other explanatory materials were added to the course web sites and were well used by students for orientation and continuing guidance on the use of the facilities where that was necessary.

Support for adoption

The project officer worked closely with the course teams throughout the complete action research cycle. She supported course teams as they gained familiarity with the Second Life environment, conceptualized and developed spaces and activities based on affordances appropriate to the needs of their course, and implemented the activities in the courses. At the same time the project officer was able to understand and document the requirements for support as guidance for supporting further course teams in the future.

Community of practice

Following the launch of the ALTC Exchange, two groups (Web3D and Virtual Worlds and Language Learning in Virtual Worlds) representing the anticipated direction of project development were created in the ALTC Exchange in December 2008. Use of the ALTC Exchange for a broader community of interest presented some challenges due to limited subscription options and apparent limitations on members from outside Australian higher education. The groups attracted little or no interest, possibly due to the early stage of development of the ALTC Exchange and limited membership at that time.

A Google Group, EREducation, was established in March 2009 as a venue for interaction among educators interested in the use of ExitReality in education. It attracted 16 subscribers in the first month and a limited amount of traffic. The group remains active with 28 members and occasional traffic, mostly questions related to technical issues encountered. The developers are participating in this community and provide support of a technical nature.

In May 2009, as a result of informal exchanges among a loose network of Australian university educators interested in virtual worlds and requests to IT sections at various universities for access to virtual worlds, a representative of AARNet made approaches to staff at a number of universities to canvass the formation of an interest group. A key motivation was to assess the network requirements for virtual world access with a view to assisting AARNet member institutions with appropriate provisions. As part of that process it was proposed to bring together some of those interested in virtual worlds at an AARNet meeting at Wollongong in September. The project leader and project officer were invited and participated in the initial video-conference. One outcome was creation of a Ning community for “Australian Virtual World collaboration” which has grown to 29 members and provides a means for communication among interested participants around the country. The interest group has interacted by teleconference several times through the year to maintain contact and share reports of progress on work with virtual worlds. The project officer attended the meeting in Wollongong and assisted with a multi-mode mixed reality presentation (participants and presenters were able to participate in the event in face-to-face mode or via the virtual worlds of Second Life or ExitReality). A recent development from this group has been formation of links between members of the group and Education.au (a not for profit company owned by ministers of the Commonwealth and State governments that provides technology based services to education across Australia) with a focus on collaborative development of a national platform for 3D virtual worlds in education. Although the development of this national grouping is not solely an outcome of this project, the project has contributed to development of what appears to be a continuing community of mutual support for Australian academics working with virtual worlds.

Discussion

Judged against a literal reading of the original goals, the project has been only partially successful. However, if the goals are considered more broadly, as they were in the second year of the project, then the level of success is appreciable, with some demonstrable achievements against each of the original proposed outcomes. They were a suite of exemplars of 3D virtual world applications in education together with supporting tools and resources, and a related Australian community of practice. Exemplars of 3D virtual worlds for education have been developed in various environments, tools and resources for supporting academics wishing to work with 3D virtual worlds have been developed, and a national community of practice is emerging among educators interested in 3D virtual worlds.

The progress of the project was affected, positively and negatively, by a combination of factors. It is worth considering some of the more important factors and the lessons that might be learned from the experience.

Factors critical to success

One critical factor for success in a project involving virtual worlds was for staff and students to have sufficient access to computer systems capable of providing a satisfactory experience with the 3D virtual worlds. Producing an experience that is as close as possible to reality makes computer games, and related 3D virtual worlds, probably the most demanding applications that are run on typical computers. Networked virtual worlds such as Second Life also require fast network connections to allow for updates of scenes and other information quickly enough for the user to maintain the sense of being in the space. Use of networked virtual worlds also involves the movement of large volumes of data and requires a high data allocation for more than very limited use. Staff and students connecting from home need systems that meet these requirements. Similar considerations apply for on-campus use where there may also be a need for changes to network configurations to enable access through institutional firewalls and other security systems. Because the connections required by Second Life were blocked for security reasons on the USQ network, it was necessary to make special arrangements for access from the offices of participating staff and from a secure laboratory provided for class use. The role of the USQ Division of ICT in providing this access was critical to the success of the project.

A second critical factor for success in the project was the development of capacity to navigate the complexity inherent in interdisciplinary work. Successful design and implementation of educational games or simulations in 3D virtual worlds involves working at the intersection of disciplines that are each complex in their own right. It requires educational design, design of the game or simulation including graphic treatment and playability, and technical elements of coding and ensuring appropriate access to the necessary infrastructure. Few, if any, individuals are likely to be able to span the complete range of knowledge and skills required. Hence it is necessary to bring individuals together and assist them to communicate across the gaps that separate their areas of expertise. Although progress was made on achieving the appropriate communication in the first year, there was more success in the second year when the project officer, who had extensive experience in both education and 3D virtual worlds, was able to assist the academic participants with planning and implementation. Although her own technical skills were limited, through her long term work with technology in education and recent years of working in virtual worlds, she had developed extensive networks that included colleagues with technical skills on which she was able to draw when necessary. Until more educators are familiar with operating within 3D virtual worlds and the technology itself requires less overt technical skill, skilled facilitation that can bridge disciplines will be a critical factor in developing educational applications of virtual worlds.

A third critical factor for success in the second year of the project was the availability of the project officer to assist participants in course teams with professional development that

went beyond necessary training in the operation of the technology. It was important that participants had opportunities to explore the changes in pedagogy, assessment and classroom management that are required to work in 3D virtual worlds that differ radically from more conventional online technologies such as Learning Management Systems (LMS). The project officer highlighted the interfacing of 3D environments and Learning Management Systems as an area for further research because all participants in the trial used the USQ LMS, Moodle, as the core location for student interaction in the non-3D components of their courses. Because all universities in Australia use an LMS of some kind, it is desirable to undertake further investigation of how to connect these environments to allow content to be shared between the environments, to facilitate student authentication, to record assessment and to allow communication between the environments.

Challenges

Although there is widespread interest in exploring the apparent educational potential of 3D virtual worlds there are significant challenges in undertaking that work in higher education.

One challenge is that many academics remain unconvinced of the benefits of 3D virtual worlds for education. In both years of the project attempts to recruit additional academics interested in application of 3D virtual environments for teaching met with limited success. Academics are busy juggling the demands of teaching and research and of maintaining currency in their core discipline while adapting to a rapidly changing learning and teaching environment including the trend toward offering more courses at least partially online. Most find it sufficiently challenging under these conditions to respond to expectations of administration and students for adaptation to conventional online learning and teaching using the established Learning Management System (LMS) and associated tools. For exploration of new technologies such as 3D virtual worlds to be attractive to most academics, more mature, easier to use tools and convincing evidence of benefits commensurate with the effort will be needed. The challenge for projects such as this one is to develop and/or apply the technologies in ways that are replicable without extraordinary effort and to gather and present convincing evidence of the value of the innovations.

The technologies around 3D virtual worlds continue to present significant challenges to their widespread adoption in education. Despite some success with transfer of 3D assets between environments and the claims of developers of Web3D environments, there is still no simple cross-platform solution for 3D virtual worlds. As new tools emerge they promise increasing ease of use but development is still at an early stage and most systems are not yet ready for routine application by non-technical end-users. Until it is possible for teaching academics to specify and implement learning activities in a 3D virtual world as easily as they can now do it in the LMS, it is unlikely that many will chose to adopt the new technologies. The challenge for projects such as this one is to develop 3D virtual worlds and associated processes in ways that support routine incorporation of such activities in courses as easily as more familiar activities such as discussion boards.

Technical and institutional challenges also exist. The Division of ICT (DICT) at USQ assessed the requirement of Second Life for certain network ports to be opened as a potential security risk. Existing network architecture at USQ did not permit simple security isolation of computers on which Second Life might be required from sections of the network used by corporate systems. Thus it was not possible to make access available routinely to staff in their offices or to students in the regular computer laboratories. Instead DICT arranged a special supervised access lab for activities using Second Life. As a result, students on campus had little access for practice between classes. This limitation slowed the skill development of the students especially in the ELCP program. The teachers all commented that, had the students had full access via student labs, they would have advanced much more quickly and their in-class activities would have benefited greatly. This challenge might be met by either implementing educational virtual worlds within the institutional security framework or by establishing suitably secure methods for accessing virtual worlds on the Internet. The work being proposed by the group associated with

AARNet and Education.au promises to address this challenge.

These and other challenges described above in relation to the first year of the project sometimes delayed progress on the project and at other times made it necessary to reappraise directions, as in the shift of focus from first year to second. However, they did not prevent progress being made and, although these challenges will continue to affect work in the area, they have been the source of learning that will contribute to the success of future work on integration of virtual worlds in higher education.

Feasibility of implementation in other locations

The overall approach adopted for this project, that is, working with a small group of early adopters to create examples that could be used to illustrate the possibilities and then supporting the original adopters as mentors for a subsequent group, appears fundamentally sound and amenable to implementation in a variety of settings. However, implementation did not proceed according to plan because of challenges encountered in the first year of the project as described above.

During the first year of the project effort was directed toward developing a series of Web3D exemplars from scratch while simultaneously developing tools for use by academics wishing to develop or customize their own Web3D environments. The challenges inherent in bringing together the perspectives required for educational design, game design, and software development using immature tools overwhelmed a small team. Such development requires substantial resources and multi-skilled teams. Achieving the project vision with the available resources proved impracticable but it is conceivable that a better resourced team, perhaps with less ambitious goals in the number and scope of exemplars, could achieve worthwhile outcomes using the approach.

In the second year of the project the approach was modified. Instead of building Web3D exemplars from scratch existing 3D environments that permitted customization were used and the Web3D developers were replaced by a project officer who had extensive experience with teaching and professional development, including in the relevant 3D environments. She worked with early adopters to develop appropriate 3D environments and engage in teaching classes in the environments. This coaching approach provided early adopters with easy access to both pedagogical and technical support and enabled an incremental approach in which environments and patterns of use could be adapted quickly in response to emerging experience of learners and teachers. This approach built practical skills and confidence of the staff who have now become advocates for 3D environments, encouraging colleagues to investigate the possibilities which was the desired effect of the original plan. Such an approach is amenable to implementation in other institutions or locations where it is possible to identify an advocate for change who has the relevant pedagogical and technical skills.

Dissemination

Project team members were active in disseminating the work of the project from the early stages of planning and throughout the period of the project. To date the following publications have resulted:

Albion, P. R. (2007). *Problem-based learning and educational technology: Exploring new horizons*. Paper presented at the International Convention of the Malaysian Educational Technology Association, Johor Bahru.

Albion, P. R. (2008). Virtual Worlds: Exploring Potential for Educational Interaction. In J. Luca & E. R. Weippl (Eds.), *Proceedings of Ed-Media 2008: World Conference on Educational Multimedia, Hypermedia and Telecommunications* (pp. 5100-5107). Chesapeake, VA: Association for the Advancement of Computing in Education.

Albion, P. R. (2008). Virtual Spaces for Teaching and Learning. In D. Gibson & Y. K. Baek (Eds.), *Digital Simulations for Improving Education: Learning Through Artificial*

Teaching Environments (pp. 52-67). Hershey, PA: IGI Publishing.
Albion, P. R. (2008). 3D Online Spaces for Teacher Education: Mapping the Territory. In K. McFerrin, R. Weber, R. Carlsen & D. A. Willis (Eds.), *Society for Information Technology & Teacher Education International Conference Annual* (pp. 1606 - 1612). Chesapeake, VA: AACE.
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Jakobsdottir, S., McKeown, L., & Hoven, D. (in press). Using the new information and communications technologies for the continuing professional development of teachers through open and distance learning. In A. Umar & P. A. Danaher (Eds.), *Perspectives on teacher education through open and distance learning*. Vancouver: The Commonwealth of Learning.
McKeown, L. (2009). Action learning in a virtual world. In J. Molka-Danielsen & M. Deutschmann (Eds.), *Learning and teaching in the virtual world of Second Life* (pp. 91-102). Trondheim: Tapir Academic Press.
Muldoon, N., Jones, D., Kofoed, J., & Beer, C. (2008). Bringing 'second life' to a tough undergraduate course: Cognitive apprenticeship through machinimas. In R. Atkinson & C. McBeath (Eds.), *Hello! Where are you in the landscape of educational technology. Proceedings of ASCILITE 2008* (pp. 653-657). Melbourne: ASCILITE.
Muldoon, N., & Kofoed, J. (2009). Second Life Machinima: Creating new opportunities for curriculum and instruction *World Conference on Educational Multimedia, Hypermedia and Telecommunications 2009* (pp. 2243-2252). Honolulu, HI, USA: AACE.

It is anticipated that further publications will be developed based on the work undertaken in the second year of the project.

Evaluation

The project plan adopted an action research framework in which evaluation was to be embedded at various stages. Methods were to include questionnaires, diaries and interviews in groups or individually, used to gather data from Web3D developers, academics, students and others involved in the project. Blogs and other devices were established to encourage participants to maintain records of their involvement but were little used. A questionnaire was developed to gather evaluative data from students working with the Web3D exemplars but delays in the development process resulted in the anticipated trial periods being missed and the data were not collected.

Throughout the project, periodic review meetings of relevant personnel were used to track progress. During the first year, the most frequent meetings were with the academics associated with the various exemplars and used techniques including structured walkthroughs and testing of prototypes to determine whether development was progressing appropriately and to adjust designs as necessary. During the second year, the project officer, who had prior experience with action research and related approaches, worked closely with the early adopters in a more typical action review cycle that guided development and implementation of their 3D environments. The early adopters maintained diaries and other records of their experience that were used as sources of data in this

process and they also gathered data from students as they engaged in the 3D environments. Period meetings also reviewed the project of the whole project.

An independent evaluation was arranged toward the end of the project. The evaluator reviewed project documents, including the original submission and progress reports, and conducted email surveys and/or telephone interviews with members of the project team and the early adopters associated with the exemplars developed in the first year. He concluded that the project had "not progressed in line with the established stages and milestones" largely due to the change in personnel involved which "had a dramatic impact on the project."

The evaluation report noted that in its first phase the project had been "subsumed by a focus on specialist developer creation of exemplars" but that the approach taken in the second phase had "enabled the project to progress and achieve demonstrable educational outcomes." It had "returned to a focus on developing capacity in early adopters" although the subsequent stage of mentoring a second group of academics would now fall beyond the project timeframe.

The evaluator concluded that, although the project did not achieve its initial objectives, it had provided a "realistic comparison between the development of a dedicated development application and the use of existing development environments." Further, the project had raised awareness of virtual environments and associated technologies at the university and established a climate through which the university is "well placed to further explore these technologies."

Continuing effects

The work of the project is expected to have continuing effects at multiple levels for some time into the future.

Content experts who participated in design of the exemplars produced in the first year of the program became aware of both limitations in the technology and the potential. The safety manager who worked on the *Escape Alive* exemplar wrote that "the game worked as intended but was designed on a very powerful computer and it wouldn't run on anything less" and "I would love to see it further developed if funds were ever available as it was very promising."

Course team members who participated in the work with Second Life in the second year of the project were very also conscious of the effort required to learn the interface and develop appropriate strategies for teaching in the virtual world but, having made that effort, consider that the benefits are sufficient to justify continuing use of the virtual world in their courses. The major barrier they encountered was gaining the necessary network access to use Second Life on campus but with that achieved integration of the virtual world into the routines of teaching is achievable.

Willingness by participants to continue working with the virtual worlds should result in further enhancement of their teaching approaches for use in virtual worlds. As they share their positive experiences with colleagues at USQ and beyond there is likely to be widening interest in the opportunities that such innovation presents. Because the participants in the project were not known for their prior enthusiasm for technology, their example is likely to be more effective for peers than would be examples in which recognized technology enthusiasts adopt innovative approaches.

The project requirement for access to Second Life has resulted in increased awareness of relevant issues within DICT and efforts to identify and implement ongoing solutions. In addition the project, together with other work by the project officer, have raised awareness across USQ of the potential of virtual worlds for teaching and learning to the point where work is progressing on developing a university-wide strategy for implementation of virtual

worlds. These initiatives can be expected to have long term strategic benefits for the university.

Through the variety of publications and presentations associated with the project, knowledge of the project is widely available to other universities in Australia and internationally and staff at other institutions are aware of the work being done at USQ and of the associated personnel. Similarly, publication of work by other institutions has led to awareness of that work by those at USQ. As a consequence contacts have been made at conferences and directly that have begun to develop a network of connections among those working in the area of 3D virtual worlds. These connections have led to sharing of experience and discussion of collaboration on future projects.

Conclusion

The emergence of 3D virtual worlds for a variety of applications is a significant worldwide trend acknowledged by numerous reports. A Gartner report suggested that "by the end of 2011, 80% of active Internet users (and Fortune 500 enterprises) will have a 'second life', but not necessarily in Second Life" (Gartner, 2007), and another from Forrester Research has claimed that "Within five years, the 3-D Internet will be as important for work as the Web is today. Information and knowledge management professionals should begin to investigate and experiment with virtual worlds" (Driver & Jackson, 2008). A recent Horizon Report has suggested that virtual worlds and related technologies can be expected to be widely adopted for education within two to three years (Johnson, Levine, Smith, Smythe, & Stone, 2009). Hence it is important that universities begin serious exploration of virtual worlds and their educational applications.

At the present time, Second Life™ appears to be the virtual world having most effect in education, including higher education. Second Life provides cross-platform, free access for users; low cost, private, customisable spaces for an institution; in-built 3D content creation tools; opportunities to access ready-made content from a wide range of developers at little or no cost as well as to tap into a large group of custom developers; a broad and rapidly expanding education community who are creating, blogging, publishing, collaborating to provide ongoing support and networking opportunities for participants. There is also now a version, Second Life Enterprise, which allows Second Life to be hosted within an institution's firewall to create a secure, private environment. Although Second Life does have some disadvantages for educational use and may eventually be supplanted for that purpose by one or other of the emerging alternatives, at this time it offers the most suitable environment in which to explore the educational affordances of virtual worlds. By adopting Second Life as the environment in its second year this project became part of a wider movement within which it could draw inspiration and support and offer a degree of leadership in the particular aspects it explored.

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Appendix

Proposed project timeline and deliverables

<table>
<tr><th>Time</th><th>Student Resources</th><th colspan="2">Staff Resources</th><th>Community Exchange</th></tr>
<tr><td>Year 1</td><td></td><td colspan="2"></td><td>Recruit people to online community</td></tr>
<tr><td>Pre-S1</td><td></td><td colspan="2">Conduct staff forum and seminar across 2 universities by Project leader & Web3D application specialist)</td><td>Design and build Exchange</td></tr>
<tr><td>S1</td><td rowspan="2">Group 1
▪ Select Teaching elements
▪ Design elements
▪ Web3D development by technology specialists
▪ Student evaluation
▪ Staff evaluation including reflective diaries
Outcome: 10 Web3D exemplars</td><td>Basic workshops on Web3D for early adopters</td><td rowspan="2">Build staff development platform within Web3D environment
Outcome: Web3D staff development platform</td><td>Audit international practice in Web3D in education
Audit technical capability of Web3D</td></tr>
<tr><td>S2</td><td>Design and implement rapid-development tools for Web3D elements
Trial tools with early adopter
Outcome: suite of Web3D tools</td><td>Exchange content maintained by student, staff and project team</td></tr>
<tr><td>S3</td><td>Recruit and train Group 2 paired with Group 1 mentor</td><td colspan="2"></td><td>Maintain support of online community through social software</td></tr>
<tr><td>Year 2 – S1</td><td>Tech-Novice teachers
▪ Select Teaching elements
▪ Utilise tools to develop Learning & Teaching elements embedded within course materials
▪ Student evaluation
▪ Staff Evaluation including reflective diaries
Outcome 10 Web3D</td><td colspan="2">Evaluation of Web3D environment for staff technology training</td><td>Exchange content maintained by student, staff and project team

Outcome: Sophisticated web site for project development and dissemination</td></tr>
<tr><td>S2</td><td>Student evaluations of outcomes
Staff evaluation of process</td><td colspan="2">Staff evaluation of tools and Web3D staff development environment</td><td>Evaluate usefulness as a learning and dissemination tool</td></tr>
<tr><td></td><td></td><td colspan="2"></td><td>External review of project through Exchange</td></tr>
</table>