How are Australian higher education institutions contributing to change through innovative teaching and learning in virtual worlds?

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Over the past decade, teaching and learning in virtual worlds has been at the forefront of many higher education institutions around the world. The DEHub Virtual Worlds Working Group (VWWG) consisting of Australian and New Zealand higher education academics was formed in 2009. These educators are investigating the role that virtual worlds play in the future of education and actively changing the direction of their own teaching practice and curricula. 47 academics reporting on 28 Australian higher education institutions present an overview of how they have changed directions through the effective use of virtual worlds for diverse teaching and learning activities such as business scenarios and virtual excursions, role-play simulations, experimentation and language development. The case studies offer insights into the ways in which institutions are continuing to change directions in their teaching to meet changing demands for innovative teaching, learning and research in virtual worlds. This paper highlights the ways in which the authors are using virtual worlds to create opportunities for rich, immersive and authentic activities that would be difficult or not possible to achieve through more traditional approaches.

Keywords: virtual worlds, VWs, Second Life, OpenSim, engagement, VWWG

Introduction and Background

The use of virtual worlds (VWs) for teaching and learning in higher education has gained increasing popularity over the last several years. As Salmon (2009) observes, it is not surprising that some early adopters of virtual world (VW) technology initially used these environments as replications of activities that could perhaps more easily and appropriately be undertaken using traditional teaching and learning technologies. However, VWs have the potential to extend traditional web based online curricula by providing an online space in which students, represented by their avatars, can learn, create, explore, gather information and collaborate in a safe environment that supports experiential learning activities (Wood, teaching and learning). These environments are increasingly being used for a range of activities including presentations, discussions, role-plays, simulations, historical re-enactments, laboratory experiments, games design, creative arts, machinima, virtual tours and career planning. Levine (2010, online) supports this view, noting findings that investigate how educators view VWs today, 'Contrary to statements that virtual worlds are passé … among educators, interest continues to be strong or growing'.

In 2010, 21 members of the Virtual Worlds Working Group (VWWG) contributed to an ASCILITE paper titled 'Australian higher education institutions transforming the future of teaching and learning through 3D virtual worlds' (Gregory et al., 2010) in which they provided a snapshot of the ways in which they were using VWs to

transform their teaching for an unknown future. Since that time there have been several important drivers that have influenced the ways in which institutions are responding to changes in the wider policy environment. The first of these drivers relates to the need for institutions to increase their capacity to offer flexible learning environments to meet the needs of an increasingly diverse student population in response to the Australian Government's widening participation agenda (Gillard, 2009). The second major driver arises from the opportunities afforded by the Australian Government's digital economy strategy, which seeks to ensure that by 2020 universities and higher education institutions will have the high speed connectivity and facilities to offer students and learners who cannot access courses via traditional means, the opportunity for online virtual learning (Australian Government, Department of Broadband, Communications and the Digital Economy, 2011). This paper provides an update on the ways in which Australian educators who are members of the VWWG are using VWs to contribute to the changes required to respond to these policy drivers through the innovative use of VWs to provide more flexible learning environments for an increasingly diverse student population. The contributions by the 47 authors of this paper reporting on 28 Australian higher education institutions provide further evidence that supports Levine's (2010) observation that the use of VWs in teaching and learning in higher education continues to increase in number and in scope.

Australian higher education institutions working with virtual worlds

The VWWG was constituted in November 2009 with 12 members from the institutions forming the DEHub research consortium: University of New England, Charles Sturt University, Central Queensland University, University of Southern Queensland and later in 2010, Massey University. In 2010 membership was expanded to all Australian higher education institutions and by mid 2010 the numbers had grown to 24. Due to growing interest, in late 2010, New Zealand educators were invited to join. The numbers currently stand at over 170 members from Australian and New Zealand higher education institutions (HEIs). The members of VWWG come from many different disciplines, specialties and expertise and use a variety of VW platforms. Second Life (SL) remains the most popular platform although the numbers using SL started to decline after the discontinuation of educational discounts to SL customers (Nelson, 2010). The work of the VWWG encompasses a variety of areas. Group members collaborate on research projects, papers, in-house seminars, presentations and also work with students across institutions. The VWWG epitomises what many higher education institutions are striving to achieve, collaboration that permits students to receive their education from the 'experts' in the field. Australian institutions represented here provide an overview of how they are using VWs for teaching, learning and research and changes that have occurred over the past 12 months since this snapshot was last reported.

Methods
A call was sent out to Australian members of the VWWG to contribute to the paper. Authors were provided with the proposed Abstract as to complete a survey, using Qualtrics, to provide consistency and gain insight into the way the authors, whose case studies are reported in the subsequent sections, are using VWs. The 47 authors represented in this paper responded to the call for submissions and this is their story. Analysis was undertaken by examining the type of virtual world each institution used, how long each institution had been using virtual worlds, the disciplines that were using virtual worlds, the number of students at each institution using virtual worlds and queries in relation to challenges and successes in using a virtual world in their teaching and learning. Themes from responses were identified and collated and are discussed in the Analysis and Discussion section.

Of the 28 VWWG Australian institutions reported in this paper, 25 are using SL, 14 Open Sim and 7 are using other platforms, such as Vastpark, iSee, Unity3D, Quest Atlantis and three customised VWs for their own needs. There are a variety of disciplines using VWs, with the most dominant in Education (22), Health (15), Business (12), Science (7) and a range of other disciplines (25), including history, art, sociology, law, engineering, architecture, visual and performing arts, tourism, hospitality, construction, languages, pharmacy, social and behavioural studies. There are approximately 200 students per HIE studying through a VW. The following snapshots represent recent experiences from Australian HEIs utilising various VWs for teaching, learning and research. This illustrates the diverse range of activities being conducted and collaborated by educators, students and researchers as well as their collective experiences. Following the snapshots is a cross-sectional analysis of the various institutions, providing ideas of what worked for various institutions and what the future may hold in relation to VWs. The snapshots are to provide potential users of virtual worlds with a reference guide.

University of New England (UNE)
UNE ventured into VWs in 2008 following the creation of the Education Online Headquarters in SL as a space for teaching and learning in the prior year (see http://www.virtualclassrooms.info). To date, over 500 education students from UNE have experienced SL for virtual tours and excursions, guest lectures, role-play, web quests, basic building and scripting, round table discussions and for fun (Gregory, 2009). Several research projects have

been conducted culminating in an Australian Learning and Teaching Council (ALTC) grant led by UNE and in conjunction with Charles Sturt University (CSU), Australian Catholic University (ACU), RMIT, Curtin University and the University of Hamburg to establish VirtualPREX, professional experience role-play for pre-service teachers with peers and bots. In other fields, students in Pharmacy and Social Work programs are using videos (machinima) and role-play scenarios created in Open Simulator (OpenSim) as part of the Social Work Pharmacy Interaction Contextualization Experience (SPICE). This DEHub funded collaboration between UNE, CSU and James Cook University is creating lifelike, immersive, communication experiences for students with input from industry and is researching their effectiveness to improve learning outcomes.

University of Western Australia (UWA)
The UWA SL presence was launched in 2009 focusing on teaching, research, art, architecture and machinima. Classes have been conducted in several degrees and with international lecturers (Canada, US, Denmark) through SL. Teaching through SL to offshore students in Singapore commenced in 2010. Partnerships have been signed with The University of Texas, San Antonio, for cooperation in Teaching and Art. In architecture, the building creators have created models for the Office of Facilities Management for long term campus planning. An international 3D Architecture Design challenge was held 2009-2010 to provide a design for the Cultural Precinct Flagship building. With Visualisation Research, initial tests have been conducted across many fields including nanotechnology, chemistry, physics, and mathematics, allowing for actively working on 3D data sets with collaborators around the world. Across arts and machinima, the art and machinima challenges have seen prizes up to L$1,000,000 (AU$3,777), some of the richest in SL, and have attracted some of the most inspirational creators in SL from around the world. Close to 1,000 entries from more than 40 nations are received over a year.

Curtin University (Curtin)
Since 2008 Curtin University academics have used SL across a range of disciplines and for different purposes. A key undertaking was the establishment of a representation of some iconic buildings and Student Central from the Bentley campus to be used as a virtual information portal for finding information about courses, faculties and services, as well as for contacting Student Services. The School of Nursing and Midwifery established a virtual wound clinic to allow students to engage in a series of activities relating to wound management and patient interaction (in partnership with Kings College London). The School of Science has been using Michael Bulwer's 'Life on an Island' in Quantitative Biology classes to create very authentic and engaging assessments. Staff and students in Curtin Business School have also conducted teaching and learning projects within SL. The School of Information Systems has used SL to facilitate a role-play assignment, involving buyers and vendors in an international collaboration with Molde University College in Norway. In 2009, an informal 3D MUVE (multi-user virtual environment) Special Interest Group was established for a more formalised and collaborative approach to teaching and learning activities in VWs.

Victoria University (VU)
Educators at VU have been deploying VWs since 2006. Initially working in SL and Teen Second Life. VU's VW activities have focused on increasing student engagement in the VET sector (construction, hairdressing, multimedia, building design) and piloting the use of VWs within the VicHealth-funded Avatar and Connected Lives projects. In 2009 VU's main project team moved to OpenSim and has since run projects using versions of OpenSim hosted externally, on local networks. In 2009 the team also began work on its flagship web-based learning management system called PushLMS. This system allows teachers to enter multiple choice or yes/no question sets that appear inworld when triggered by avatar actions. In 2010 the team used PushLMS to build a virtual unsafe construction site where students triggered questions by exploring and clicking on unsafe workplace practices. Monash University's Pharmatopia has adopted PushLMS, an open source system, trialing undergraduate students in the Bachelor of Pharmacy.

University of Queensland (UQ)
The Foundation Year Business Island in SL (moving to OpenSim) gives students access to a virtual trading environment. Operating as managers within eight businesses, students are able to implement strategic plans and compete with other businesses while receiving guidance from teachers and leaders within the business community. In Education, SL is used to demonstrate the features and possibilities of VWs to pre-service teachers. Mathematics and Statistics use a custom built web based 2D world, 'The Island' to simulate a virtual population consisting of towns, households and individuals. This supports teaching in experimental design, epidemiology and statistical reasoning. Religious studies use 'The Religion Bazaar' (Farley, 2010) that has buildings from a variety of religions to teach first year classes and for supervising distance postgraduate research students. In Pharmacy a virtual compounding dispensary has been built allowing students to practice pharmaceutical calculations. This is located on the Pharmatopia islands in SL (moving to OpenSim), a multi-institution collaboration using a shared practice model where each school develops and shares a simulation. The

Faculty of Health Sciences is planning a virtual medical facility for immersive scenario based learning where interdisciplinary teams collaborate on patient treatment plans from emergency care through to rehabilitation. It aims to develop clinical, communication, problem solving and teamwork skills.

University of Adelaide (UniAd)
'Getting a MUVE On' based in the History discipline aims to evaluate a re-creation of eighteenth-century London in SL. It was used to illustrate lectures, run inworld tutorials and for the design of learning tasks. Students in the pilot course completed inworld assessments which entailed constructing a display including a critique of historical research they had conducted and writing a reflective journal (Matthews, 2010; Lemmings et al., 2010). Meanwhile the 'Transforming Assessment' island in SL was created as a professional development resource targeted at academics with the aim of improving assessment practice within VWs and other online environments. The SL island and website (transformingassessment.com) showcases approaches to e-assessment across a range of disciplines. Examples in SL (Crisp, Hillier & Joarder, 2010a) include using the Sloodle Chair for quizzes integrating both inworld and web content, Sloodle Awards that provides instant and comparative feedback, a chat logger that links inworld and external participants, QuizHUD with 'touch to answer' exercises and using chat bots (scripted avatar robots) to provide interactive quizzes and simulated discussions (Crisp, Hillier & Joarder, 2010b).

TAFE NSW Western Institute (WIT)
WIT provides vocational training (VET) across 65% of western NSW, including many remote locations. In 2010, funded by the Australian Flexible Learning Framework, a project focused on developing virtual tourism learning experiences to engage young learners, specifically VET students and remotely located trainees. The WIT Virtual Campus is currently utilised by Tourism & Hospitality students for a range of web quests and role-play activities. WIT Virtual Campus was established in OpenSim enabling students aged from 15 to 60+ to access a common space. Learning materials are brought to the Virtual Campus via Sloodle through the Learning Management System (LMS). TAFENSW is part of the Department of Education & Communities (DEC) where policies relating to firewall management practices bar the use of innovative technologies such as teaching and learning in VWs using the DEC portal and intranet. Firewall barriers are the keystone to expansion in the delivery base and WIT are balancing the desire to explore technology use in teaching and learning while maintaining the integrity of the IT systems network.

Queensland University of Technology (QUT)
QUT has been utilising SL to facilitate teaching and learning in a variety of modes since 2007. SL machinima have been used to contextualise legal principles in a number of projects such as Air Gondwana (negotiation skills) (Butler, 2008), Entry into Valhalla (legal ethics) (Butler, 2010) and The Sapphire Vortex (criminal liability, responsibility and procedure). All utilise detailed sets created on QUT Island. These projects are testament to the ability of machinima to make real world connections to otherwise abstract principles and to create cost effective learning environments that are both engaging and challenging. QUT Island also provides synchronous learning in both architecture and interior design. Students have used SL to obtain an introduction to 3D modeling and as a simulation of the built environment in creating landscape architecture while others have been involved in the creation of the QUT Space Station, which requires the design and construct of a complex microgravity environment reflecting not only community, connection and inhabitation but also physical expression. Students of advertising, marketing and public relations have also used SL to experience VW immersion and to appreciate 3D implications for marketing including branding, public relations, advertising and sales perspectives (Mathews & Bianchi, 2010).

University of Ballarat (UB)
In 2009 UB created an online SL presence and purchased its own island, including the creation of an online campus which houses interactive lecture theatres, meeting rooms, University promotional literature and specifically built research orientated simulations for different schools and associated academics. Critical Life is a simulated emergency room (ER) to expose nursing students to possible real life scenarios. First created in 2008 Critical Life has since been expanded upon and refined to encapsulate six different scenarios focusing on common ER crises. Critical Life has found to be a valid and embraced environment in which student nurses found it to be a highly beneficial to simulated exposure and also team-based learning. In 2009 the Virtual Stuttering Support Centre (VSSC) created a multi-story building - a hub of self-support for people who stutter (PWS). The VSSC conducts PWS support groups, presentations and meet with other interested people. Members are encouraged to verbally communicate in a safe and supportive environment.

Monash University (Monash)
Monash University Behavioural Studies department first piloted a lecture in SL in 2007. Although technically challenging, the inherent potential of the platform encouraged the lecturers to expand their use of SL as a teaching environment. Since 2009, Digital Selves, a final year subject, has been offered, focusing on equipping students with theoretical and applied knowledge and experience of the implications for identity, privacy, communication, teamwork, commerce and community that are affected by digital mediation. In 2008, the Faculty of Pharmacy and Pharmaceutical Sciences developed a virtual laboratory in SL where students could learn how the pharmaceutical industry manufactures tablets and also the role of ingredients in shaping a tablet's physical properties. The virtual laboratory is a safe learning environment that students can access anytime. The development of the virtual laboratory led to an international collaboration of 12 schools of pharmacy in which each school develops a learning activity on the 'Pharmatopia' island. Chinese Island is designed to complement traditional classroom-based learning with task-based, contextualised learning in a high fidelity virtual environment of Chinese language and culture. Learning on Chinese Island encompasses a range of inworld learning activities, from realistic task-based scenarios, to role-play, quests, the making of television chat shows and news-desk reporting.

Charles Sturt University (CSU)
The School of Information Studies built the CSU-SIS Learning Centre on Jokaydia in SL in 2009, a customised facility to support the teaching of distance education (DE) courses (Hay & McGregor, 2010). Library and information management and teacher librarianship subjects use SL requiring students to complete a number of learning activities inworld. DE students are encouraged to attend inworld discussion sessions hosted by faculty, guest speakers or student presentations; join a range of professional and educator groups; attend professional development activities; visit a range of libraries, university campuses, professional and education spaces; and meet with their lecturers for individual consultation (Gregory et. al., 2010). An evaluation of academics' and students' experiences using SL was conducted in 2010 (Hay & Pymm, 2011) with general consensus from both students and staff that the provision of teaching and learning experiences in SL is very worthwhile. In 2011 staff are exploring new ways to support teaching, research and professional development activities in the CSU-SIS Learning Centre. In the design of energy efficient buildings, students from the School of Education have made good use of Google SketchUp's 'geo-location' feature to place virtual buildings onto a site where it is subjected to simulated sunlight at designated times of the day and year. Using this virtual environment, students walk through buildings and to assess according to their incorporation of passive solar design principles.

Deakin University (Deakin)
Deakin supports a cohesive digital simulations program that includes VWs to encourage flexible, student-centred and accessible teaching and learning. Ubiquitous etechnologies support augmented reality and virtual simulations (Grenfell and Warren 2010) to enhance work related learning (Devlin, Coates & Kinzie, 2007) enabling students to access learning content. In 2007, the building of the Arts Education Centre on Deakin Island in SL began. Later, Criminology, Nursing and Occupational Therapy precincts and an introductory skills development zone were established. To promote greater collaboration, three islands were merged to form a single integrated virtual campus. Currently, undergraduate students, undertaking an elective art subject, are immersed in elearning artifacts embedded within the Deakin LMS system and in virtual and real world art studios. Students move seamlessly from text based content, still and moving images, audio and movie clips, located in the LMS and inworld to real time studio activities using traditional media and techniques or digital image manipulation software. Collaborative learning is experienced and students conduct inworld presentations of their artworks, culminating with a virtual exhibition of artworks in the art gallery in SL.

University of South Australia (UniSA)
UniSA has been active in VWs since 2007. Trials in the use of VWs for health science role-play simulations, experiential learning, defence simulations, performing arts and games design have been widely disseminated (see Fewster, Chafer & Wood, 2010; Fewster & Wood, 2009; Gregory et al., in press; Gregory et al., 2010; Wood, 2010a, 2010b,). Findings suggest: a) students put effort into virtual learning experiences providing they can see the direct relevance between learning activities and their future career aspirations; and b) students studying externally are more positive about the potential of VWs than students studying on campus. The School of Communication, International Studies and Languages is extending its teaching and learning activities with a focus on enhancing and supporting the development of students' career skills in areas such as journalism and professional communication. UniSA is currently developing a virtual careers centre using OpenSim, which will provide students with access to a wide variety of written and multimedia based career learning and information

resources. UniSA is also developing a range of interactive scenarios to better assist students identify and articulate their employability skills.

MacICT Virtual Worlds Project – NSW DEC and Macquarie University (MacICT)
The MacICT project assists classroom teachers in primary and secondary schools to develop curriculum-specific units of work using OpenSim. The objective is to develop programs which maximise student learning outcomes and cyber-citizenship, through engaging students in design and construction activities in the VW. Programs involving sculpture, sustainability, learning spaces and architecture have been completed, covering Visual Arts, English, Mathematics and Human Society and Its Environment. Each program aims to engage students in design tasks with real-world implications, for example designing students' ideal learning spaces for a location at their school. Project evaluations have found that the design and construction activities in the VW can: facilitate students' understanding and application of concepts and design processes; support development of spatial awareness; be highly engaging; encourage collaboration and team work; and enable design resolutions that students are proud of by allowing rapid visualisation and refinement of design ideas.

University of Canberra (UC)
In 2008 the Faculty of Information Sciences and Engineering (ISE) acquired land in SL (Telework, Telework Space, UCISE and UCISE Project). The two Telework regions are largely used for research into virtual work environments and sustainable VW ecosystems and as a platform for scripting and demonstrating artificial intelligence applications (Campbell et al., 2007; Cox & Crowther, 2008; Cox, Crowther, & Campbell, 2009). The Telework regions are also used to support postgraduate research training and projects. It hosts examples of interactive art and artificial intelligence. The underwater environment located in Telework Space is rich in free-roaming artificially intelligent objects. ISE subjects utilise the UCISE and UCISE Project spaces in SL and focus on construction of objects, scripting, land management and practical applications of VWs to industry. Students have the opportunity to acquire high-level skills in building and scripting complex objects (see Ryan, 2009, for an example of student work). In 2011 ISE established a 16 sim OpenSim grid.

University of Tasmania (UTas)
At UTas post-graduate students are exploring the potential for VWs in their own teaching contexts. Students engage in ethnographic research of the textual, discursive and social literacy practices occurring across a range of new media spaces including VWs and other social networking sites. In particular, English teachers and their classes are exploring how complex, esoteric and poetic concepts of texts can be constructed and examined critically in VWs. The site of Virtual Macbeth is being used for research with several secondary English classes. Classroom management is being used with teachers in Australian schools who need to demonstrate a capacity to engage and manage the behaviour of pupils in order to be effective leaders of learning. These skills are not easily practised in the university setting and are often acquired by default during professional experience placements. Trials in SL with pre-service teachers taking the role of students have stimulated development of OpenSim, enabling social exchanges to be private, replacing volunteers with 'bots' to improve learning efficiency.

University of Southern Queensland (USQ)
USQ was an early entrant into VWs in the Australian context. In 2005, the Advanced Learning and Immersive Virtual Environment (ALIVE) project began at USQ, with the aim of providing easy to use, Web3D elearning content development tools for educators (de Byl, 2009). The difficulties and high cost associated with creating a bespoke 3D environment became obvious and given that environments such as SL were emerging, the project was discontinued. Given impetus by this earlier work in 3D environments, USQ hosted a virtual careers fair in SL in 2008. In 2009, the careers fair was held in Exit Reality (McIlveen at al, 2009). USQ has positioned itself at the vanguard of VW use in higher education. In 2007, the first sim in SL provided housing to a variety of immersive teaching activities relating to Law, German language learning, Australian literature and education. In 2011, a second sim was created to explore the restorative possibilities engendered in Indigenous and virtual environments. USQ's exploration of this space continues with the development of an in-house OpenSim grid. National and international projects are being formulated in Unity3D, Minecraft and Kitely.

Griffith University (Griffith)
Griffith School of Education has used a variety of VWs since 2007: the Appalachian Educational Technology (AET) Zone; their own SL island and Quest Atlantis (QA). The School is currently developing VWs in OpenSim, MineCraft and Cryengine. In SL pre-service teacher preparation experience different simulated classroom teaching environments, comparing spatial arrangements and availability of arrangeable space for individualised, collective and collaborative learning. They also explore how student and teacher stereotypes (via avatar role-play) can influence teaching practice (Zagami, 2010) and create collaborative constructions in virtual environments to improve understanding of peer communication that increase complexity and creativity. Arts

education concepts are taught via virtual excursions, performances and installations to prepare students to use VWs in primary and middle years to meet curriculum goals through QA and to participate in international multi-university online projects to develop understanding of the effectiveness and challenges of collaborative online projects. Postgraduate courses use VWs as examples of educational technologies in AET and SL, enhance online course discussions in SL and compare various VWs for achieving curriculum goals (Zagami, 2009).

Southern Cross University (SCU)
In 2009 SCU Interaction Island was purchased. In 2010 Commerce Town was developed to support teaching scenarios in programs in the School of Commerce and Management, Law and Justice, Hospitality and Tourism and Education. The buildings on this island represent a range of business premises and have been realistically constructed to facilitate role-playing and teaching scenarios (Phillips & Ellis 2011: Jacka & Ellis, 2011; and Jacka, Logan & Ellis, 2011). The School of Education has been active in its use of Commerce Town for pre-service teacher courses in visual art, science and technology and learning technologies. In 2011, DBA Island has been constructed to support the International Doctor of Business Administration Program. The students and staff come from throughout Australia and overseas so the SL platform provides an ideal way to bring them together. In 2012 a fourth island is under consideration to allow for facilities to be constructed to expand teaching and role-play scenarios in additional courses in the School of Education and the School of Nursing.

Royal Melbourne Institute of Technology (RMIT)
In 2009, researchers in the School of Electrical and Computer Engineering developed a virtual TV studio learning environment in SL (Neville, Burton, & Burnett, 2010) aimed for use in courses taught at both the Melbourne and Ho Chi Minh City campuses. A significant component of these courses is the practical experience. Students learn to design and create multimedia content, use advanced audio/video editing, mixing tools and the RMIT TV studio. The RMIT Vietnam campus does not have a TV studio facility, thus the SL virtual studio mirrors the City Campus TV studio aiming to help bridge the facility gap and enable student collaborations between the two campuses. The City Campus TV studio is a fully operational facility and with avatar interactivity in SL, the virtual studio mirrors the studio and control rooms (and communications/feeds), props, cameras, and DMX lighting rig with static and intelligent lights. Currently being integrated into LMS coursework repositories using Sloodle for alignment with course material, students can communicate with teachers and student peers, keep a record of their studio setups for class sessions and save the 'film' that they have created in the virtual studio for assessment. Trials using the virtual studio are ongoing with local students to obtain feedback on its effectiveness before deployment across both campuses.

University of Western Sydney (UWS)
UWS has both developed the technology of VWs and utilised that technology for education purposes. Research has been focused on technology for electronic trading, cultural studies, tourism and emulation of processes in hospitals. Core technology is based on the integration of formalized social norms, Artificial Intelligence and VWs. The Westopia Island in SL is used by the School of Computing and Mathematics for teaching, developing new methods of human-computer interaction, game technologies, social informatics and professional communication. A SL project, Uruk, recreates humanity's first city in ancient Mesopotamia and simulates daily life using Artificial Intelligence (Bogdanovych et al. 2010). Education uses it for experiments in creating immersive teaching materials, in particular, history. Students learn about the daily life in Uruk by 'living' there and interacting with virtual 'inhabitants' who are agents aware of where they 'live', hence the history learning happens through interacting with them. The team has developed technology for controlling avatars via a motion capture suite for applications in sports, health informatics and tele-health.

Swinburne University (Swinburne)
Swinburne's Koala Island in SL caters for two groups of students, on-campus students and Open University Australia (OUA) students. On-campus students have been exploring the VW of Exit Reality alongside SL. However, the lack of 'virtual life' within Exit Reality has been a constant issue for students and consequently they prefer SL to do their business model analysis. Over the last year there has been an increase in usage by distance and OUA. They have been made up of post-graduate students undertaking IT subjects. These students have been using the island for group discussions for subject related matters and exploring the island together in groups as part of their get to know routine and ice breaking. This has been a new development and is very encouraging given the difficulty surrounding group work involving distance of OUA students. To facilitate these, several cubicles have recently been built and usage of these spaces is readily noted. Despite the growth in usage and popularity of the island in SL there are discussions to move to OpenSim due to funding.

Central Queensland University (CQU)
In 2008, CQU Learning Island opened with a welcome area providing signposts for spaces and events enabling one to teleport directly. Interests were strong initially for usage of SL as the platform for micro-worlds, but there were concerns about the requirements for sufficient bandwidth and computational power for effective use of the environment. Organisational issues impeded the use of SL, with some campuses blocking access at the network level. Issues around cognitive load was also explored by the research team as it had been observed that as users spend most of their time trying to learn how to navigate through the unfamiliar environment, instead of planning, articulating and thinking about their ideas; it was hindering learning. The research interest then shifted to exploring the educational potential of SL machinima and CQU integrated the use of machinima in curriculum and instruction (Muldoon et al. 2008; Muldoon & Kofoed, 2009). In this longitudinal design-based research, machinima were used as an anchor for apprenticeship style learning in the classroom.

University of Sydney (Sydney)
Sydney's Faculty of Architecture is using SL for lectures, demonstrations, tutorials, exhibitions, interactions and discussions where students collaborate on designs, presentation and exhibition and are critiqued by teachers in SL in conjunction with Istanbul Technical University, Turkey and Yuanze University, Taiwan. Being together increased the awareness of others' activities and social presence, which mimics characteristics of face-to-face learning. The Estate USydney in SL facilitates teaching instrumentation, process dynamics and process control concepts in the Faculty of Engineering and IT. Equipment found in oil refineries was built in SL with simulated behaviour augmenting practical learning. A challenge facing this engineering application of SL is interfacing the environment with dynamic simulations that mimic real process behaviour. Students in SL engaged with instructor and peers. International students, with preliminary English skills, favoured SL over local students (Abbas, 2010). A Sydney and Macquarie University project explores the use of educational virtual worlds to develop scientific inquiry skills in secondary school science education. This project uses Unity 3D to design the Omosa Virtual World enabling students to engage in scientific inquiry in biology as they investigate the mystery of a plummeting population of megafauna in a scenario inspired by Australia's unique natural history. Students are encouraged to gather and analyse data to solve the mystery of ecological crisis on Omosa.

James Cook University (JCU)
When developing an on-call hospital ward simulation at JCU, it was considered that the limitations of third party platforms were too restrictive to capture the real world nuances that exist within the communications and interactions of patients and medical professionals in a hospital ward. The lack of control over the technical facilities of the underlying technology also limited the ability for customised data capture for formative feedback and automated elearning assessment. The imposition of available interface options starkly contrasted real world interactions. In response to these problems, the medical ward environment was created using Unity 3D with avatars and medical models created in AutoDesk Maya. Unity 3D offered high resolution 3D graphics with superior performance, networking support, ease of importing 3D objects, terrain builder, audio capabilities, light mapping for realism (reflections and shadows) plus avatar customisation and animation. In addition, Unity 3D provides the ability to read and write from files and to interact with a database. These features provide a basic infrastructure and make data capture for assessment and feedback more flexible. Using Unity 3D a prototype of the on-call hospital ward simulation was developed featuring virtual patients with intelligent conversation system, networked supervisor observation console and time-stamped log files of interactions.

La Trobe University (LaTrobe)
La Trobe's Faculty of Humanities and Social Sciences built an island in SL in 2007, providing a series of learning, teaching and meeting spaces based on LaTrobe's bush campus and the laneways of central Melbourne. An open-air lecture theatre modeled on LaTrobe's amphitheatre and a sandpit and campsite were also provided. Initial uptake from academic staff was slow and depended on individual enthusiasm. A virtual Art Gallery was added in 2008 and is used to showcase student work in photojournalism. The Faculty of Law and Management is about to use the space for mooting classes and projects have been conducted in Nursing and Education.

The University of Melbourne (UniMelb)
Researchers at UniMelb are studying the use of VWs and online games, researching: the impact of voice communication on user experiences in online communities (Wadley & Gibbs, 2010); problems of mutual awareness during collaboration around objects in SL; building and studying networked games that employ 'exertion over a distance'; and the ongoing negotiations of rules and conventions by users of VWs.

Australian Film Television and Radio School, (AFTRS)
In 2006 Esperance was established in SL and used for educational and pervasive game applications through the Laboratory of Advanced Media Production (LAMP) including 'Thursday's Fictions' combining art, poetry, real life performance and spiritual exploration. The Graduate Media curriculum uses SL for sound design for games, cinematography, machinima pre-visualization, script development through role-play, VW creation and 3D art as well as hosting mini conferences with international media schools.

Analysis and Discussion

In 2010, the VWWG presented a snapshot on institutions using virtual worlds in their institutions (Gregory, et. al., 2010). At this time, 21 authors from the 22 members of the VWWG contributed to the paper. There has been a rise in popularity with contributions for this paper increasing to 47 authors from 28 institutions. Members of the VVWG were asked a variety questions in a survey to provide current information on what is happening in the Australian VW sector. Table 1 indicates when each institution began using VWs at their institution.

Table 1: Opt in year of using virtual worlds of institutions represented in paper

Year			Institution
1998	UWS	2007	Griffith, LaTrobe, Monash, QUT, Swinburne, UNE, UniSA, UB
2005	USQ	2008	CQU, Curtin, Deakin, UC, UQ
2006	AFTRS, Sydney, VU	2009	CSU, RMIT, SCU, UWA
		2010	JCU, MacICT, UniAd, UTas, WIT

As can been seen in Table 1, UWS began using VWS in 1998, however, the uptake from other members of the VWWG has been since 2005 with the use of immersive VWs such as Second Life. Table 2 outlines key responses in the survey from the authors of these institutions on two questions; the key things that they are using VWs for and the unresolved challenges that VWs present.

Table 2: Institutional responses on experiences of teaching, learning and research in a virtual world

Question	Key responses
List three key things that you are doing in a virtual world	Research; providing students with virtual experiences unavailable to them; meetings; tutorials; social media; inter-professional education; ethical decision-making; experiential learning, collaboration; role-play; simulation; guest lectures' web-quests; excursions; tours; scenario based training; building; scripting; authentic assessment; programming behaviour of avatars and objects; interfacing VWs with motion capture suits and cybergloves; design and implement distributed sports games
What are your current biggest unresolved challenges	Technical and financial support; bandwidth; acceptance; accessibility; lack of vision; preparation of materials; many people on the one sim at the one time; timetabling, learning curve

What do virtual worlds provide or enable?

The themes that emerged from content analysis of the snap-shots and survey responses were assessment, collaboration, communication, engagement, stepping stones and simulation and that the following discussion elaborates on the responses according to each of these identified themes. Virtual worlds provide ACCESS where ACCESS is an acronym for assessment, collaboration, communication, engagement, stepping-stones and simulation.

Assessment – While not necessarily its key strength, VWs provide a vehicle for assessment. An advantage of setting assessment tasks in a VW is that marking can be automated. They are also a useful venue for conducting assessment tasks when other barriers are in play. Typically this would involve physical barriers (for example a disability) or a geographic barrier. UniAd have established 'Transforming Assessment' island in SL as a resource for academics to improve VW assessment activities, as well as Curtin, using 'Australis 4 Learning'.

Collaboration – the VWWG itself is an exceptional example of collaboration. Members have produced over 300 articles on VWs. VWs play an important role in overcoming the tyranny of distance and as a result, members report increased collaboration and networking not only between students, but also between staff and especially with international collaborators. Phrases such as, 'the ability to develop and participate in cross-disciplinary, cross-institutional and cross-border research and collaboration' is one that most members of the VWWG relate to. Many institutions report international collaboration on research and teaching (expert international guest lecturers are invited to present at various institutions to students at little or no cost). Where else but a VW could a student be provided with interaction from these experts? To the authors' knowledge, to date there have not been any similar collaboration internationally with the exception of academics from New Zealand universities who are part of this group.

Communication – At one level communication is at the heart of what VWs do. Collaboration and simulations, for example, highlight the power of VWs as a synchronous communication tool. VWs have a special role in asynchronous communication. VWs have been used as a vehicle to demonstrate student work and machinima is often used for demonstrations or for students to submit assessment tasks. QUT and CQU have used machinima as a vehicle to make real world connections to otherwise abstract principles. Higher education institutions and institutions generally have, to some extent, used VWs to communicate something about who they are. For instance SCU have designed a virtual presences mirroring their physical presences, Deakin highlighted their strength in the visual arts by their appealing use of colour and light.

Engagement – While engagement is a multidimensional concept, the authors generally acknowledge that engagement exists when students have a sense of energetic and effective connection with the activities they are undertaking, for example, one author commented that there was a 'high level of engagement in virtual world-based activities by young male construction students'. Many members reported increased engagement of students. This may be reflected in increased participation, increased interaction and a greater willingness to share. VWs provide an increased sense of 'being there' that has resulted in increased student perception of their engagement and is correlated with increased student grades. VWs play an active role for engagement (or at least the student perception of engagement) effective (feelings) behavioural (observable actions or performance), cognitive perceptions and beliefs (Finger & Asun, 2001). Possibly the most significant venue for engagement is in simulations, and it is so important, that it has been allocated a category of its own.

Stepping-stones – Virtual worlds provide stepping-stones to overcome barriers. These barriers may be physical, cultural, geographic, psychological or even financial. For example VWs have a role in reducing performance anxiety, supporting international students and students with a disability to increase confidence and participation. VWs have been used to create a virtual support centre and this provides skill development opportunities as much as it provides solutions for the users. Several institutions reported that they used VWs to eliminate many of the social and cultural barriers to engagement in the classroom.

Simulations – Simulations provide a rich tapestry of opportunities for educators. VWs have been used as mock trials, a virtual pharmaceutical compounding dispensary (UQ) pharmaceutical virtual laboratory (Monash) and defence (UniSA, CSU, USQ). Even at a less complex level VWs enable educators to add lifelike contexts to learning and to contextualise otherwise abstract and dry education principles.

Challenges for Virtual Worlds

The learning/inconvenience curve and physical constraints (bandwidth and computer hardware) are two significant impediments to VWs. 'Lag' (slowing of the computer) is a common problem experienced when many (upward of 30) students share the one virtual space. Lag is a function of bandwidth and computer capabilities (especially RAM). Some VWs cope with lag better than others. The learning/inconvenience curve comes about because software needs to be downloaded on a computer and then a set of basic skills needs to be acquired (movement and communication). Often this whole process could be achieved within two hours with good guidance. Experienced 'gamers' would do it much quicker. However, this is just to function at a basic level. Often these impediments are overlaid with institutional constraints (e.g. firewalls) and financial constraints. Much VW work has been initiated on minimal budgets by motivated academics. This effort must be leveraged by budgets and institutional support to deliver the higher dividends offered by VWs (e.g. simulations).

How have these challenges been overcome?

Some members of the VWWG reported that they upgraded computer equipment in laboratories enabling better access for on-campus students. However, they were not able to provide this support for off-campus students. When students took on this expense themselves they found it improved their VW experience. When technical support was available during initial workshops many issues were overcome. Staff were provided with professional development immersive learning experiences and research and professional literature on VWs to give them a better understanding of the virtues of VWs. Members of the VWWG also worked with their staff to identify potential applications of VWs. Support from senior management assisted in overcoming many barriers as this support enabled academics with the financial and time required to provide VW experiences to their students and other staff. Staff also reported on the development of appropriate non-player characters to assist with teaching and designing of pedagogy, lessons and tasks. Collaboration with other institutions provided professional development, guest lecturers or join forces during lessons with students. Many members report that they used external assistance such as machinima and non-player characters to assist with their lessons. As VWs are currently undergoing dramatic change, many members of the VWWG are migrating to other VW platforms.

The above list of successes of using a VW in teaching, learning and research outline how a VW could be used as an educational tool. The HEI discussions demonstrate that virtual worlds have been used for various learning scenarios and across a variety of disciplines. VWWG members were asked to respond to how their teaching or use of a VW has changed. Grant Meredith, UB, encapsulates the many responses: 'Our teaching using SL has extended more towards multi-discipline awareness and education regarding the possibility of VWs being integrated into curriculum. We are continuing this education process at the moment to step up embracement and experimentation. We are continuing to experiment and evaluate group interactions and meetings within VWs'. These challenges and solutions can guide those planning to undertake teaching and learning activities in VWs.

Future and Conclusions

VWWG members see the future application of VWs, as outlined by Helen Farley, USQ, as: 'I think browser-based VWs will become more common and make OpenSim and SL more accessible by circumventing current ICT security issues associated with these platforms. Gesture-based computing will similarly become more commonplace. Gaming consoles such as Kinect and Nintendo Wii will push this trend. In turn, this will lead to activities supporting authentic learning and become a cost-effective way of providing authentic learning experiences at a distance.' There are many similar experiences outlined in this paper. Although some institutions may be a couple of years ahead of others, they have all learnt from each other and new users are able to learn from the more experienced users. Higher education teaching, learning and research are changing and educators need to embrace the opportunities that VWs provide to ensure their students receive the best possible immersive and engaging education that Australia can provide. 47 authors reporting on 28 institutions have demonstrated how the Australian higher education sector are addressing continuous changing demands by utilising VWs into their teaching, learning and research repertoire of resources. Not all Australian universities were represented in the paper and due to limited space, an in-depth analysis was not possible and content analysis was thus also

limited by number of responses by members of the VWWG. The changes from the 2010 snapshot (Gregory, et. al., 2010) to this snapshot highlight the emergence and collaboration that has taken place in the VWWG. Further research should be undertaken to provide readers of a more in-depth analysis and cross-section of teaching, learning and research currently being undertaken by the HEI across Australia.

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