Institutional support for and barriers to the use of 3D immersive virtual worlds in higher education

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Anecdotal evidence suggests that despite recognising the potential benefits of 3D immersive virtual worlds for learning and teaching, many academic staff have chosen not to adopt them, due in large part to the complex array of technical and policy hurdles that must be negotiated in order to make use of such resources within higher education institutions. This paper presents selected results from the questionnaire phase of an Australia and New Zealand-wide scoping study of the use of 3D immersive virtual worlds in higher education. The particular focus in the paper is on findings from the questionnaire about support provided within institutions, technical and other barriers encountered by those considering adoption, and whether and how these were overcome.

Keywords: 3D immersive virtual world, *Second Life,* institutional support, technical issues

Introduction

3D immersive virtual worlds such as *Second Life, Active Worlds* and *OpenSim* have garnered considerable attention and interest in recent years, with many higher educators seeing great potential for supporting and enhancing learning and teaching. In line with this growing attention and interest, studies of uptake and usage of these environments in higher education institutions have yielded evidence of steady growth (see, for example,

Dalgarno, Lee, Carlson, Gregory & Tynan, 2010, 2011; Kirriemuir, 2007a, 2009c, 2010b). In spite of this, anecdotal evidence and evidence from the literature suggests academic staff who have used virtual worlds in their teaching have done so despite being met with numerous technical barriers and, in some cases, policy barriers within their institutions. It may therefore be reasonable to assume that there are many other staff who have intended or planned to use the technology in light of its potential learning benefits, but have not done so because of these barriers.

This paper reports on selected data collected from a sector-wide questionnaire administered as part of a scoping study on the use of virtual worlds in higher education in Australia and New Zealand, which is being undertaken by researchers at Charles Sturt University and the University of New England with support from the Distance Education Hub (DEHub at http://www.dehub.edu.au/) consortium. Earlier publications from this project (Dalgarno et al., 2010, 2011; Lee, Dalgarno, Gregory, Carlson & Tynan, 2011) have reported on the range of discipline areas in which respondents have used virtual worlds and the types of virtual world-based learning activities they have designed for their students to undertake. In the present paper, the particular emphasis is on the aspects of the questionnaire data relating to institutional support, barriers encountered and ways in which these have been mitigated or overcome. It is hoped that the findings and insights presented here will be of value to academic staff considering introducing such environments into their teaching by helping them become aware of some of the issues they may face at an early stage in their planning.

Background

The following definition of a '3D immersive virtual world' (hereafter referred to as a virtual world) has been adopted for the present study's purposes:

> a computer-based, simulated environment in which users are able to immerse themselves, and within which they are able to, through their avatars (computer-based representations of themselves or alternative selves), experience, manipulate, interact with and/or create virtual objects and places that are graphically depicted in three dimensions. The objects and places within a virtual world may be modelled according to those in the real world or may be fantasy based. Most current virtual world applications allow for multiple users and include facilities that enable users to communicate and interact with one another within the virtual environment. (Lee, 2010, p. 2)

In 2007, the New Media Consortium's *Horizon Report* (NMC and EDUCAUSE Learning Initiative, 2007) singled out virtual worlds as one of the emerging areas likely to impact higher education within a two to three-year timeframe. The inaugural edition of the Australia–New Zealand version of the *Horizon Report*, which was released in the following year (Johnson, Levine & Smith, 2008), named 'virtual worlds & other immersive digital environments' as technologies to watch with a time-to-adoption of one year or less. The number of virtual worlds in existence is ever on the rise, with numbers predicted by some to exceed 900 by the year 2013 (Mitham, 2008), but Linden Labs' *Second Life* is widely acknowledged as the most popular platform in higher education. Cummings (2010) estimates that approximately 750 institutions operate their own islands in *Second Life*, which does not take into account those that own smaller parcels of virtual land.

Recognising the clear increase in interest in and usage of virtual worlds in higher education and the specific prominence of *Second Life*, Warburton (2009) cautions that the pedagogical promise and value of this new technological environment must be appropriately weighed against the barriers to managing and using it for learning and teaching. He outlines eight broad issue areas that represent barriers relating to the use of *Second Life*, based on a survey of Internet newsgroups, blogs and extant literature:

15. *Technical issues*, including bandwidth, hardware, firewalls, downtime and lag as well as usage problems such as navigation, object creation and avatar manipulation.
16. *Identity issues* faced by users as they grapple with the fluidity and playfulness inherent in identity construction in the virtual world.
17. *Cultural issues* such as the difficulty of finding, developing a sense of belonging to and becoming an active participant of an in-world community, as well as the need to become comfortable and familiar with the codes, norms and etiquette rules of the virtual world.

18. *Collaboration issues* that have to do with the challenges in cooperation and co-construction within a virtual world, and the minimal social networking tools and functions available.
19. *Time issues* and the associated workload impositions on educators in not only mastering the technology but also designing and implementing learning activities and resources that make use of the technology in pedagogically sound ways.
20. *Economic issues*, including the cost of purchasing land, uploading images and textures, buying in-world objects/tools, and employing skilled people to perform building and scripting tasks.
21. *Standards issues*, specifically the lack of open standards and interoperability between virtual world platforms, which limits educators' and institutions' ability to transfer resources between platforms.
22. *Scaffolding persistence and social discovery issues,* the former of which arise from the fact that although the virtual world itself is persistent, persistence for avatars only exists when their users are online, and the latter of which are due to the limited functionality of the in-world profiles associated with each avatar as compared with egocentric social networking services on the Web such as *Facebook* and *LinkedIn*.

Building on the widespread interest and acknowledged potential of virtual worlds, a number of sector-wide and cross-sector reports on their use in education have been published in Europe and North America, but the DEHub virtual worlds scoping study is the first of its kind focusing on the Australasian region. The overseas reports are optimistic about the opportunities and potential offered by the technology, but also highlight a number of challenges and barriers that exist. For example, one of the earliest of these reported on the results of a May 2007 survey run by the NMC (2007) in the United States to collect information on the activities, attitudes and interests of educators in *Second Life*. Of the 209 respondents, 113 (54%) claimed they were involved in an education-related activity in *Second Life*. The respondents to the NMC survey were also asked to describe their most positive and negative experiences in *Second Life*. The positive experiences described related predominantly to the richness of in-world interactions and the opportunities for meeting new people and to expand social and professional networks, in addition to the generosity of the in-world community in offering assistance. Respondents most frequently cited issues of a technical nature, including the steep learning curve required to master the software, as being among the most negative aspects of their experiences.

In the same year the NMC survey was carried out, the US-based EDUCAUSE Center for Applied Research released a research bulletin on *Second Life* in education, drawing on extant literature as well as on interviews with various North American educators and innovators in the area (Kelton, 2007). The diverse examples of virtual world use in higher education showcased in the bulletin demonstrate some of the many applications that are possible. Nevertheless, the author warns that "[h]istory has proven that higher education incurs real risk when entering into a close alliance with a for-profit company when consistency for academic purposes is such an important issue" (Kelton, 2007, p. 9), and discusses a number of obstacles to broad-scale adoption of the technology. He echoes the NMC survey respondents' comments about technical problems and the complexity of using the *Second Life* software, and moreover observes that "[b]ecause those involved with Second Life appear to be having fun, some have come to question it as a serious teaching, learning, or research tool" (p. 8). In a later article Kelton (2008) expands on this discussion, classifying the challenges into four major categories:

- *Perceptual:* This includes challenges caused by the misconception that virtual worlds are all games, as well as other negative ideas about the use of virtual worlds in education that are perpetuated by the mass media.
- *Technical:* While technical issues relating to bandwidth, processing and memory will be overcome with time, two major technical hurdles needing to be addressed at this time, according to Kelton, are the lack of tools for facilitating truly collaborative interactions between users in real time and the lack of interoperability between the different virtual world platforms.
- *Operational:* The three main issues in this category are the need to learn how to use the tool, the occurrence of server downtime and the existence of legal age restrictions.
- *Pedagogical:* This category relates to the educational value and assessment of the technology as well as the intellectual property and ownership issues involved.

The UK Joint Information Systems Committee (JISC) scoping report on 'serious virtual worlds' (de Freitas, 2008) also identified a number of opportunities and challenges facing their use for educational purposes. It named creating more engaging, personalised and student-centred learning experiences, especially for hard-to-reach and unmotivated learner groups as well as those studying at a distance, as a particular area of opportunity, along with providing support for learners with disabilities or mobility issues to help reduce the need for them to travel. Other opportunities suggested by that report include empowering learners to construct their own spaces, content and activities, facilitating cross-disciplinary collaborative research and learning initiatives, as well as mixing or 'blending' virtual and real spaces and experiences. Some of the challenges identified by the JISC report include accessibility and the need for broadband connectivity, the development of open standards, and the

provision of support for practitioners in the form of guidelines, case studies and implementation models.

Also in the UK, John Kirriemuir has conducted a number of 'snapshot' surveys sponsored by the Eduserv Foundation examining the uptake and use of virtual worlds in British universities and colleges, the findings of which are documented in a series of rolling reports. Eight reports in the series have been produced thus far (Kirriemuir, 2007a, 2007b, 2008a, 2008b, 2009a, 2009b, 2009c, 2010b) – the first four were funded by Eduserv as individual investigative projects, and the rest were published under the auspices of Virtual World Watch. The eight snapshot reports successively display an upward trend in the numbers of academics and universities that are using virtual worlds, so that by the time of writing the Winter 2009 report (Kirriemuir, 2009c), evidence had been found of the technology being used to some degree at all but one university in the country. The first few of the snapshots in the series pointed to problems in terms of the negative reactions staff using virtual worlds were receiving from their colleagues and peers, but the later snapshots indicated that the situation in this regard was slowly improving over time. Workload levels, funding, resources and support appear to be persistent complaints, as do technical issues, causing the need for staff to put in large amounts of their personal time in order to sustain their projects and efforts in this area. Kirriemuir (2010a) expounds on his findings in relation to technical support in an article published in a special issue of the journal *Educational Research*. Drawing on qualitative data gathered from the first six snapshot surveys, he lists four categories under which comments from respondents about technical issues fell: 'updating the Second Life viewer', 'technical capability' (i.e. hardware, software, network), 'port, firewall and proxy issues' and 'lack of knowledge of virtual world use in education' (on the part of IT support departments). Based on the survey data as well as informal correspondence from academics, he details a number of recommendations in the way of possible solutions to the technical obstructions and limitations, arranged under the headings of 'IT awareness of virtual worlds in teaching and learning', 'national minimum standards for IT innovation support', 'flexibility of high-end IT provision in universities' and 'greater production of support materials and software by Linden Labs'. According to Kirriemuir (2009c), where institutions have managed to overcome institutional technical barriers and support issues, substantive virtual world developments have taken place.

Evidently, despite the substantial interest in virtual worlds among academic staff and the growing body of examples and success stories of the use of such environments in higher education learning and teaching, the international studies reviewed above show that a number of important issues and challenges are frequently encountered. To some extent these issues are similar to those identified in studies of early adoption of other technologies for learning and teaching in higher education. For example, Samarawickrema and Stacey (2007), in a study of adoption of learning management systems (LMSs), found that academic time, technology problems and funding limitations all impacted upon successful adoption. Similarly, in a review of studies spaning five decades in the school education sector, Leggett and Persichitte (1998) pinpoint time, expertise, access, resources and support as key implementation obstacles.

The aim of this paper is to report specifically on the issues faced by academic staff in Australia and New Zealand when integrating virtual world technology into their teaching.

The study

In early 2010, supported by funding from DEHub, the authors began a comprehensive scoping study of the use of virtual worlds for higher education learning and teaching in Australia and New Zealand (see Dalgarno et al., 2010). This scoping study, which will conclude in 2011, involves a systematic review of current and planned applications at institutions across the two target countries, with the goal of capturing and understanding how virtual worlds are being used across universities and disciplines. The present paper reports on a portion of the data acquired from an online questionnaire completed by 117 Australian and New Zealand higher education staff in June-August 2010 as part of the scoping study.

The questionnaire was developed using an iterative process, including pilot testing by 10 respondents prior to the creation of the final version. *SurveyMonkey* (http://www.surveymonkey.com/) was used as a delivery platform for the questionnaire, and it included questions grouped into the following sections: demographic data; views and beliefs about the potential of virtual worlds for learning and teaching; summary information about subjects/units in which virtual worlds had been used; detailed information about a single subject/unit in which virtual worlds were used; and success factors and barriers to the use of virtual worlds in learning and teaching. The present paper draws on the questionnaire items concerning respondents' experiences as they pertain to

institutional support and problems encountered, in addition to those soliciting respondents' advice and recommendations for the future. As well as approaching individuals directly via email to request their participation, the questionnaire was made available through various electronic mailing lists/listservs and web-based communities. As an incentive, those completing the questionnaire were able to opt to be placed in a draw for a chance to win their choice of either an 8GB iPod Touch or $250AUD paid as Linden Dollars (the currency used in *Second Life*).

Following on from the questionnaire phase of the scoping study, interviews are currently being conducted with up to 30 people from the questionnaire respondent list in order to allow more in-depth information and insights to be obtained. These interviews are semi-structured and approximately 60 minutes in duration. A cross section of participants from a range of institutions, including academics from various discipline groups, educational designers/developers and IT support staff, are being interviewed. The results from the interviews will be reported in future publications.

Findings

Respondents

The 117 respondents to the questionnaire included 59 males, 56 females and 2 who did not specify their gender. There were 9 respondents in the 26-35 years age range, 40 in the 36-45 years age range, 46 in the 46-55 years age range, 19 in the 56-65 years age range, and 1 in the over 65 years age range, with 2 who did not specify. Of the 117 respondents, 89 were academic/teaching staff, 9 were educational designers/developers, 6 were learning and teaching management staff, 7 were research students or other research staff, and 6 did not specify their job roles. The respondents included 82 from Australia and 35 from New Zealand. 62 of the respondents indicated they had actually used virtual worlds in their teaching, and this group identified 125 discrete subjects/units in which they had done so. These 62 respondents were asked to complete a section of the questionnaire in which they were invited to provide more detailed information about one particular implementation of virtual worlds in their teaching.

Summary of platforms used and support provided

As part of the more detailed information provided about a single implementation of virtual worlds, the majority of participants (49 or 79%) indicated that they had used *Second Life* as the platform, with *Active Worlds* (4 or 6.5%) being the next most commonly used platform, followed by *OpenSim* (2 or 3.2%) and *There.com* (1 or 1.6%). Respondents were also asked whether a virtual world, island or space was developed specifically for the purposes of the subject/unit, and if so, they were asked to provide details. 31 respondents indicated that they had developed a world or space specifically for the subject, while 25 indicated that they had not. An analysis of the additional details provided revealed that 13 of the respondents had purchased new land or space, 12 used an existing space with 7 of these indicating that they had developed new environmental features within it, and 3 rented or borrowed a space, with one of these indicating that they had developed new environmental features. Most of the Australian participants who used an existing island or space indicated that their institution owned it, while a number of New Zealand respondents indicated that they used land provided by the SLENZ group (see http://slenz.wordpress.com/).

Respondents were asked whether they had drawn on the support of other staff within their institution, and if so were asked to give details. 31 respondents specified that they had drawn on such support, while 25 specified that they had not. In providing details about who provided the support, 16 listed IT support staff, 9 listed educational designers, 6 listed academic colleagues, 3 listed casual staff or students, 2 listed project officers and 1 listed library staff. Respondents also listed 10 categories of support provided. Consistent with the fact that the most frequently cited support role was IT support, almost all of the categories of support related to IT aspects of the work rather than pedagogical aspects. Specifically, 9 mentioned the solving of connectivity or firewall issues, suggesting that many university networks do not readily allow the use of virtual worlds. Additionally, 8 mentioned that they had received support with the development of the environment, which perhaps illustrates that developing environmental features within a virtual world is still not something that most academics can be expected to do themselves. Other categories of IT-related support included support with installing and configuring software (5 responses) and the provision of ongoing technical support (4 responses). Non-IT

categories of support that were identified included the running of workshops for staff or students (3 responses) and pedagogical support (1 response).

Respondents were asked whether they had obtained dedicated funding to support their implementation and/or use of virtual worlds in the subject/unit, and if so were asked to provide details. 30 respondents indicated that they had received funding, while 26 indicated that they had not. The funding sources described were categorised according to whether they were research (5 responses), learning and teaching (13) or not specified (7), and whether they were internal within the institution (11), external (3) or not specified (11). The most commonly described grant source was internal learning and teaching grant funding (8 responses). The fact that more than half of the respondents had relied on some sort of funding beyond the normal funding allocated for teaching implies that the use of virtual worlds is still at the early-adoption stage. If and when it becomes more mainstream and grows into a standard component of the university teacher's technology toolkit, it is conceivable that the need for separate, dedicated funding and support will fade.

Limitations identified and problems encountered

Respondents who described a particular implementation of virtual worlds were asked to describe the main problems and stumbling blocks that impeded their efforts. In addition to this, all participants were asked to list up to five general limitations/disadvantages of virtual worlds for university learning and teaching, the three most significant barriers and the three most critical success factors in the implementation and use of virtual worlds in university learning and teaching. There was considerable overlap in the answers to these four questions, so they were coded using a common set of categories. 26 categories were identified and these were then clustered into 7 higher-level categories: technology (see Table 1), support, funding and time (see Table 2), usability and familiarity (see Table 3), equity and ethical issues (see Table 4), inherent limitations of virtual worlds (see Table 5), acceptance of virtual worlds (see Table 6), and management and planning (see Table 7).

The most frequently mentioned problems were those under the broad category of technology. As shown in Table 1, the main technological problems identified were lack of sufficient bandwidth, firewall issues, hardware requirements and audio problems. In alluding to bandwidth as an issue, most did not specify whether the problems were at the student's or the institution's end, but it appears from the wording used (e.g. "broadband issues") that they meant home rather than university Internet bandwidth. A number talked about poor performance as an issue, which was in some instances put down to the bandwidth and in others to the computer hardware used on campus. An additional technological problem reported in several instances was difficulties in getting in-world audio communication to work. More general technological problems represented in the data included reliability of student Internet access and problems with students getting the virtual world software to work on their computers off campus.

Table 1: Technological problems, limitations and success factors

Category	Number of mentions as a limitation	Number of mentions as a barrier	Number of mentions as a success factor	Number of mentions in relation to a particular subject
Bandwidth	47	19	6	14
e.g. *"limited to people with broadband Internet"* *"connecting from home always presents the user with problems in our regional area"*				
Firewalls and other IT policy issues	34	31	18	10
e.g. *"campus IT infrastructure limitations (bandwidth, security firewalls, etc)"* *"firewalled at the University so all work by the respondent done at home after hours"*				
Hardware requirements	25	11	8	6

e.g. *"availability of computers with the necessary system requirements whether they be university or the students' own computers"* *"some students did not have the technology to enable them to enter Second Life which is why it could not be compulsory"*				
Audio problems	2	0	2	4
e.g. *"initial problems with voice for some students"* *"there were technical issues of trying to get students to talk (in real time) to each other (voice and text)"*				
General technology requirements or problems	32	18	10	9
e.g. *"some students weren't able to get their software to run on their computer"* *"challenges in configuration of applications on desktops"*				

Table 2 lists issues associated with lack of support, funding or time to devote to the activity. A distinct message here is that successful implementation of virtual worlds requires management and IT support together with additional funding, coupled with substantial time commitment from the lecturer. It is not clear from the responses the degree to which the availability of land through the SLENZ group was helpful to New Zealand participants in getting started with the use of virtual worlds in their teaching, but one might expect that it may have at least partially reduced the funding needed at the initial stages.

Table 2: Support, funding and time related problems, limitations and success factors

Category	Number of mentions as a limitation	Number of mentions as a barrier	Number of mentions as a success factor	Number of mentions in relation to a particular subject
Time commitment	25	23	17	5
e.g. *"commitment and enthusiasm of lecturer for that mode of pedagogy"* "[lack of] *time to devote to project"*				
Cost and funding	19	26	12	4
e.g. *"cost to students and institutions (Internet charges, land rentals, etc)"* *"lack of resources to keep application current and well supported in a teaching context"*				
Management support	5	7	11	0
e.g. *"support from intuitional management/ IT department on board – i.e. the infrastructure issues"*				
Resources – general	0	0	6	0
e.g. *"sufficient resources to build something worthwhile"*				
Support – general	16	16	32	4
e.g. *"support across the university from academic and general (IT support) staff"* *"lack of understanding/help from IT support"*				

Table 3 lists the problems identified that were linked to staff or student ability to use the relevant software. Some referred to students' IT skills as the major problem, while others cited their own learning curve or the lack of familiarity of their academic peers as an issue. Still others laid blame on the software's usability.

Table 3: Usability and familiarity problems, limitations and success factors

Category	Number of mentions as a limitation	Number of mentions as a barrier	Number of mentions as a success factor	Number of mentions in relation to a particular subject
Student user familiarity and learning curve	24	7	5	8
e.g. *"getting students au fait with the mechanics of the 3D world, how to move around ..."* *"students slow to acquire requisite control of the technology and interface"*				
Academic user familiarity and learning curve	12	13	8	3
e.g. *"many lecture*[r]*s are still new to us*[ing the] *3D environment"* *"colleagues are generally 'scared' of learning to use SL* [Second Life]*"*				
General user familiarity and usability of software	13	7	8	8
e.g. *"complex software that is difficult to learn"* *"challenges with setup and the proficiency learning curve / intuitiveness"*				

Table 4 summarises responses relating to ethical or equity issues. These included inappropriate behaviour by students and others in the virtual world, the problems of obtaining institutional clearance to use virtual worlds in teaching, and the difficulty of ensuring all students had access.

Table 4: Equity related and ethical problems, limitations and success factors

Category	Number of mentions as a limitation	Number of mentions as a barrier	Number of mentions as a success factor	Number of mentions in relation to a particular subject
Ethical issues	23	3	1	1
e.g. *"possible griefing by rogue users"* *"supporting unsocial character development"* *"getting ethical clearance to use a 'social networking' tool with students"*				
Equity issues	3	3	0	0
e.g. *"access and equity – financial and age restraints"*				

Table 5 summarises responses identifying inherent limitations of virtual worlds as tools for learning and teaching. Issues highlighted included problems with communicating through an anonymous avatar and limits in non-verbal communication in a virtual world, a lack of clarity about the actual learning benefits of virtual worlds, limits in the authenticity or fidelity of visual simulations in a virtual world, and the potential for students to be distracted by the game-like appearance of a virtual world or by irrelevant objects and avatars within the world.

Table 5: Inherent limitations of virtual worlds and associated problems, limitations and success factors

Category	Number of mentions as a limitation	Number of mentions as a barrier	Number of mentions as a success factor	Number of mentions in relation to a particular subject
Limitations of communication mode	18	1	1	0
e.g. *"not being able to identify people outside of the avatar appearance"* *"interaction is very much through an interface, face-to-face behaviour and practices could be lost"*				
Need for clarity of learning benefits	9	8	16	0
e.g. *"needs to provide opportunity not possible in other methods"*				
Limits in the authenticity of the representation	4	0	0	0
e.g. *"possible missing of steps in real world process unless the virtual experiment is set absolutely accurately"*				
Student distraction by virtual world or game like appearance	6	0	0	0
e.g. *"technology can distract from learning"*				

Table 6 lists problems associated with student or academic acceptance of the potential value of virtual worlds for learning and teaching. A recurring issue here seemed to be the fact that students and other staff often did not initially see in-world learning activities as something to be taken seriously.

Table 6: Acceptance of virtual worlds and associated problems, limitations and success factors

Category	Number of mentions as a limitation	Number of mentions as a barrier	Number of mentions as a success factor	Number of mentions in relation to a particular subject
Student acceptance	15	7	9	8
e.g. *"student reluctance to use the technology"* *"students were concerned about the validity – saw it more as fun than as a learning tool"* *"students thought it was weird and decided against it"*				
Academic staff acceptance	11	6	13	1
e.g. *"when it is not valued by current assessment, students and staff do not usually value it"* *"general scepticism of other faculty"*				
General acceptance	8	17	6	2
e.g. *"bad press of VWs – although dropping off",* *"resistance to a new paradigm concerning teaching and learning"*				

Table 7 summarises responses in which management and planning issues are highlighted. The need for careful and considered planning in terms of the design of both the environment and the learning activities was heavily

represented in the questionnaire data. Difficulty in organising for students and staff to be able to synchronise given their diverse locations, time zones and commitments was another recurring problem identified. Many respondents stressed the importance of opportunities for professional development and for sharing and collaboration between teaching staff involved in the use of virtual worlds.

Table 7: Management and planning associated problems, limitations and success factors

Category	Number of mentions as a limitation	Number of mentions as a barrier	Number of mentions as a success factor	Number of mentions in relation to a particular subject
Planning for learning (content, outcomes, timelines)	12	1	32	0
e.g. *"*[need for] *clear purpose and goals in the implementation"*				
Design and development of the environment	10	0	7	0
e.g. *"creation of useful, repeatable simulations can be difficult"*				
People synchronisation issues	6	2	0	0
e.g. *"time zone differences can make synchronous participation challenging"*				
Continuity as subject is revised and/or teaching staff changed	0	3	0	0
e.g. *"the way courses are passed from lecturer to lecturer inhibits continuity"*				
Need for workshops, meetings, training	0	0	6	0
e.g. *"professional development of staff that includes pedagogical changes and task modification needed to maximise new learning opportunities in 3D"*				
Need to collaborate with others	0	0	5	0
e.g. *"good support from educational community and good contacts with relevant people"*				

Solutions offered

Respondents describing a particular implementation of virtual worlds in university teaching were asked what they had done or planned to do to overcome these problems. All respondents were also asked what additional advice and/or recommendations they had for other university colleagues contemplating the use of virtual worlds for learning and teaching. Responses to these two questions were coded using a common set of categories and the results are summarised in Table 8. Interestingly, although the vast majority of the problems identified (see tables above) were technology related, the most frequently mentioned recommendations had to do with professional development (primarily suggesting that the more professional development undertaken by the lecturer, the better), followed by recommendations related to learning design (a common theme here being that the use of virtual worlds requires a clear pedagogical purpose). There were, however, a number of recommendations related to the virtual world platform (often suggesting a move away from *Second Life* to other platforms), IT support (especially the need to obtain approval to bypass or 'punch through' the firewall) and computer laboratory infrastructure. The value of research, scholarship and networking were also underscored, along with the need for ongoing time commitment and for thorough planning.

Table 8: Recommendations and advice

Category of recommendation	Number of times mentioned in relation to overcoming problems in a particular subject	Number of times mentioned as additional advice or recommendation
Professional development	11	6
e.g. *"I will continue to learn as much as possible myself so as to enable me to reduce my reliance on technical assistance"* *"Attend classes, meetings, events and explore in the virtual world to learn from others and don't limit this to universities"*		
Learning design	6	8
e.g. *"Continue to develop lesson designs, tools, the environment and the bots to the point where they overcome the ... challenges and enable the learner experience of interacting with the environment"* *"Has to be a purpose for the learning other than simply being in SL* [Second Life]*"* *"We used machinimas to overcome the problems we encountered during the design stage"*		
Technology infrastructure	8	1
e.g. *"Put in a case for a new lab with equipment designed to facilitate SL* [Second Life] *teaching";* *"Provide open access to labs were students can practice and play in SL* [Second Life]*"*		
Virtual world platform	8	0
e.g. *"Moved to an open source platform (Project Wonderland) so we could work with Java and not pay a third party for ... land"* *"moved to OpenSim on a LAN to avoid dealing with Linden Labs"*		
IT support	5	3
e.g. *"Made submissions to ICT regarding access – firewalls are supposedly coming down* [next year]*"* *"collaborative approach to dealing with the politics of getting it through the damn firewall"*		
Research, scholarship and evaluation	5	3
e.g. *"More focused research to explore the factors effecting 'intuitiveness' as it pertains to Second Life and medical education"* *"One current 3D MUVE project has benefited from the experiences of the earlier encounters and this has resulted in design elements helping to facilitate student engagement"* *"Read what others have done in this field"*		
Networking	3	5
e.g. *"I networked with other people using Second Life in education, in particular the New Media Consortium"* *"network and connect with the 'experts' and mentors who are already using VWs in education"*		
Policy and support	2	6
e.g. *"Attempted to explain to the gatekeepers that if innovation is desired then gates must be opened and barriers removed"* *"Give yourself time and get support"*		
Time and commitment	2	5

e.g. *"It takes time to get on top of the virtual world and its capabilities but once you have reached a sufficient level of familiarity the potential for creating engaging and effective learning experiences is boundless"* *"Also be prepared to commit substantial time to the effort, but have fun in doing so"*		
Planning	0	3
e.g. *"Make sure that resource requirements (R&D, support, hardware, software) for a proposed system are detailed and costed in advance"* *"Plan everything. Have a Plan B, and a Plan C, and a Plan D"*		

Discussion and conclusion

This paper has provided a summary of the experiences and perspectives of 117 respondents to a questionnaire relating to the use of virtual worlds for higher education learning and teaching in Australia and New Zealand. In particular, the paper has summarised the platforms used, the problems and limitations encountered and the solutions to these problems offered by the respondents. Many of the problems and limitations identified by respondents – including 'time commitment' and 'support' – are reminiscent of those that have emerged from other university technology-adoption studies (e.g. Wilson et al., 2000; Kilmon & Fagan, 2007; Samarawickrema & Stacey, 2007), while others relate more specifically to the use of virtual worlds – for instance, 'limits in the authenticity of the representation' and 'student distraction by virtual world or game-like appearance'.

As with earlier studies and reports from other countries (see, for example, Warburton, 2009; Kelton, 2007, 2008), the most frequently reported problems in the present study were technological in nature, with bandwidth and firewall issues along with hardware requirements to use the client software being the most commonly raised. Another issue identified by many respondents related to the learning curve students and academic staff are confronted with as they attempt to become adept at using the software; this mirrors findings from the NMC (2007) survey. Evidence from other studies suggests that these technical and usability challenges will gradually be overcome, and research and development initiatives around the world are yielding useful, evidence-based resources such as practical guides and handbooks to assist academic staff in their use of virtual worlds in their teaching (see, for example, de Freitas & Rebolledo-Mendez 2008; Savin-Baden, 2010). Nevertheless, it is apparent that from a technical perspective, online learning and teaching cannot be undertaken as seamlessly in a virtual world as it can when using other more established technologies provided within institutional LMSs.

The theme of institutional support was also prominent in the questionnaire responses, including both the need for management support and provision of resources as well as the need for ongoing technological support. A related issue that emerged was the need for funding for virtual environment development and additional time allocation for teaching staff. These issues were also emphasised by Warburton (2009), as well as by Kirriemuir (2010a) in his article on UK university and college technical support for *Second Life* developers and users and in his various snapshot reports. It is important to additionally note that the questionnaire was administered during 2010, prior to the decision by Linden Labs to remove educational discounts on the purchase and rental of land in *Second Life* (Linden, 2010). Consequently, it is likely that cost issues are even more pronounced for higher educators now than they were at the time when the data were collected.

Similar to the findings of Kelton (2007, 2008), an additional problem commonly reported by the questionnaire respondents in the present study was a lack of acceptance by staff and students of virtual worlds as legitimate or 'serious' learning tools. This had implications for a number of respondents, as manifested in a lack of 'buy in' on the part of students and other academic staff. Like Warburton (2009), who described problems with students being unfamiliar with the behavioural norms of virtual worlds, a number of respondents identified anti-social in-world behaviour as a concern. These types of problems are likely to remain while the use of virtual worlds is an activity undertaken only by a small proportion of the population, but could be expected to diminish as usage becomes more mainstream. Bowers, Ragas and Neely (2009), in a study of post-secondary instructors' adoption of virtual worlds, found that 80% of respondents were in either the first ('innovators') or second ('early adopters') stage of Rogers' (2003) five stages of technology adoption. Findings from Kirriemuir's UK-based snapshot reports (see, for example, Kirriemuir, 2007b, 2010b) imply that there are specific issues faced by these early-stage adopters.

Solutions and recommendations for the future offered by respondents included the need for professional development, clear planning from both a technological and pedagogical perspective, and networking with other educators with experience in the use of the technology. It is prudent to note that despite the emphasis in this paper on the negative aspects of respondents' experiences, elsewhere in the questionnaire, they were asked about the degree to which a series of possible learning benefits actually occurred during the implementations of virtual worlds they described. Their responses to these questions were highly favourable – for example, 93% of respondents expressed agreement with the statement "the use of 3D immersive virtual worlds was motivating and engaging for students", 84% agreed with the statement "the use of 3D immersive virtual worlds led to more effective collaborative learning", and 87% agreed that "the use of 3D immersive virtual worlds allowed learners to learn through experiences in context". There is evidence to suggest that many of the problems and obstacles respondents faced were to a large extent surmounted, and from their perspective, valuable student learning can and in fact did occur.

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