3D immersive virtual worlds in higher education: An Australian and New Zealand scoping study

Barney Dalgarno, Mark J.W. Lee & Lauren Carlson
School of Education
Charles Sturt University

Sue Gregory, Belinda Tynan
DEHub
Faculty of the Professions
University of New England

This paper reports initial findings of a major scoping study that is being undertaken to examine current and planned applications of 3D immersive virtual worlds at higher education institutions across Australia and New Zealand. This scoping study is the first of its kind in the region. It is parallel and complementary to several studies conducted in other countries, and results obtained thus far appear consistent with international trends. The overall research design of the scoping study is discussed, along with preliminary results from the Australian/New Zealand sector-wide questionnaire. There seem to be preferred platforms being used in the Australian and New Zealand context, and usage has increased dramatically in recent years. Academics are using 3D immersive virtual worlds with their students in a variety of ways, for both assessable and non-assessable tasks. The project is supported by the Distance Education Hub research consortium, with team members from Charles Sturt University and the University of New England.

Keywords: 3D immersive virtual world, 3D multi-user virtual environment, *Second Life*

Introduction

Much attention and interest are being given to 3D immersive virtual worlds such as *Second Life* and *Active Worlds* and their potential for supporting and enhancing tertiary learning, teaching and pedagogy. Academics from two Australian universities, Charles Sturt University (CSU) and the University of New England (UNE), are currently working on a project to conduct a systematic review and environmental analysis of the use of 3D immersive virtual worlds in higher education in Australia and New Zealand. This work is parallel and complementary to other similar sector-level research already completed in other parts of the world. The 12-month project seeks to identify and examine existing applications of 3D immersive virtual worlds by educators throughout the two countries, with the aim of developing an understanding of how the technology is being used for learning and teaching across institutions and disciplines. The project will also report on the views and perceptions of educators who are not yet using 3D immersive virtual worlds in their teaching but are actively exploring the possibilities, as well as the experiences of those who have previously considered this avenue but have chosen not to pursue it or been otherwise unable to do so.

The study is being carried out under the auspices of the Distance Education Hub (DEHub at http://www.dehub.edu.au/), a federally funded research consortium based at UNE that involves UNE, CSU, Central Queensland University and the University of Southern Queensland in Australia, and Massey University in New Zealand. In late 2009, DEHub established a Virtual Worlds Working Group (VWWG) to assist in facilitating cross-institutional collaborative research into 3D immersive virtual

worlds, striving to identify research gaps/needs and to define, document and promote good and/or best practices in this area. The scoping study project will provide the VWWG, as well as ascilite and the educational technology and higher education communities at large, with exemplars, guidelines and recommendations to encourage the successful uptake, implementation and use of 3D immersive virtual worlds by educators, institutions and their students.

The timeliness of a scoping study with this Australian and New Zealand focus can be demonstrated, for example, in the range of papers and sessions dealing with this topic at the 2009 ascilite conference, where no less than 13 papers relating to 3D virtual worlds and multi-user virtual environments were presented. These papers collectively illustrate the diversity of research and practice in the use of 3D immersive virtual worlds in Australian and New Zealand higher education. For example, within this collection of papers there are reports of applications in a wide range of disciplines including teacher education (Campbell, 2009), nurse education (Rogers, 2009) and cultural studies (Henderson, Huang, Grant & Henderson, 2009); and research studies with a wide range of foci including educator perceptions (Gamage, Tretiakov & Crump, 2009), student perceptions (Gregory & Tynan, 2009) and virtual world teaching practices (Willems, 2009).

This paper begins with an overview of the extant of the key literature, before describing the background and overall motivations or rationale for the scoping study project. It then details the study, including its aims and objectives, research design/methodology and dissemination methods. Next, the preliminary findings of the sector-wide questionnaire are reported. Finally, the paper concludes with a discussion of emergent themes from the preliminary results and an outline of the project team members' plans for the remainder of the study.

Key literature, background and rationale for the study

The working definition of a '3D immersive virtual world' adopted for the purposes of the project is that proposed by Lee (2010, p. 2):

> 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.

In the United States, the 2007 *Horizon Report* (New Media Consortium, 2007) classified virtual worlds as an emerging area likely to impact higher education within the next two to three years. Subsequently, in the following year, the inaugural edition of the Australia–New Zealand version of the *Horizon Report* (Johnson, Levine & Smith, 2008) was released, and it pinpointed 'virtual worlds & other immersive digital environments' as a 'technology to watch' with a likely time-to-adoption of one year or less. In a recent review of empirical research covering both K-12 and higher education settings internationally, Hew and Cheung (2010) found that 3D immersive virtual worlds were being used for three main purposes: (i) as communication spaces, (ii) for simulation of space (spatial), and (iii) as experiential spaces ('acting' on the world). Lee (2009) analysed cases of 3D immersive virtual world use in education, with an emphasis on the collaborative aspects of the facilitated learning activities. In addition to the powerful affordances of the technology and the rich possibilities it offers for enhancing and enriching the student learning experience, higher education is faced with an imperative in that, as argued by Collins (2008), it "has a significant role to play … [as] Business and industry will be looking for an educated workforce ready to meet the challenges these new environments present, from new modes of marketing, design, and manufacturing to new kinds of management and organizational leadership models that leverage virtual environments as one option in a suite of online tools serving the needs of companies and their customers" (p.56).

The Joint Information Systems Committee (JISC at http://www.jisc.ac.uk/) in the UK has already commissioned a scoping study on serious virtual worlds in the British education and training industry, and published a report of its findings (de Freitas, 2008). This report includes a thorough review of the field, plus case study examples that are representative of the multitude of ways in which 3D immersive virtual worlds can be and are being used for learning, including but not limited to mentoring,

constructionist activities, exploratory trails and quests, role plays and skill practice. According to the report, virtual worlds also have the potential to support a range of cross-disciplinary collaborative research and learning opportunities that are only starting to emerge. Additionally, the JISC report provides valuable resources for researchers and practitioners, such as a typology and a list of 3D immersive virtual worlds.

Also in the UK, as an outcome of a project funded by Eduserv (http://www.eduserv.org.uk/), Kirriemuir (2008) presents a 'snapshot' of the use of *Second Life* in higher education and further (i.e. vocational) education. Like the JISC report, the Eduserv report testifies to rapid growth in the number of UK academics using *Second Life* for learning and teaching, estimating that some three-quarters of UK universities are actively developing or using *Second Life* at the institutional, departmental and/or individual academic level. A large proportion of these activities and initiatives are funded internally, with staff frequently donating considerable amounts of their own time. As with the JISC study, academics who participated in the Eduserv study made reference to a broad spectrum of 3D immersive virtual world-based activities spanning the domains of learning, teaching, research, performance, demonstration and construction.

The EDUCAUSE Center for Applied Research (ECAR at http://www.educause.edu/ecar/)in the USA has also issued a research bulletin on *Second Life* in education, focussing primarily on the tertiary sector (Kelton, 2007). This bulletin provides coverage of both technological and pedagogical aspects, drawing on recent literature as well as interviews with several educators and innovators. Again, similar to the UK reports mentioned above, the content of the ECAR bulletin, especially the examples included of how academics are using *Second Life* as a training, teaching and research tool, speaks to the wide variety of applications that are possible. Indeed, the author of the bulletin observes that "it seems as if each institution is using this tool in a way that reflects of its own perceived need" (p. 5). He goes on to comment that "being able to state with any certainty what most or many institutions are doing is difficult at best … [which] is further complicated by the fact that in some instances it is one individual, department, or even academic unit that constitutes the institution's presence" (p. 5).

In Australia, Bradshaw (2006), in her report for the Australian Flexible Learning Framework (http://www.flexiblelearning.net.au/), looked at virtual world usage in the VET (vocational education and training) sector, where she found that virtual worlds had the potential to be used in ways that are engaging for students, encouraging creativity, learning through simulations, experimentation and observation while promoting increased immediacy, expanded horizons and the building of self-awareness. There is a need for research that is parallel and complementary to the above and concentrates on the Australian and New Zealand higher education perspective, transcending isolated 'show-and-tell' and anecdotal reports to accurately depict and represent in detail the unique opportunities, challenges and realities of the technology and its deployment and use within the highly dynamic, evolving national higher education context in these two countries.

The DEHub scoping study project is intended to address this need, culminating in the provision of analysis and recommendations to inform policy, practice and future research in the field. It is particularly significant for a number of reasons. Firstly, no Australian and/or New Zealand study of its kind has been undertaken to date, and there has been no national capture of activities, uses and impact of the use of the 3D immersive virtual worlds for enhancing higher education learning and teaching in either country. Secondly, there is a need for an accurate picture of the 'state of play', including current, past and planned applications at the various institutions, so as to help direct future research, development and use. Thirdly, the compilation of an annotated bibliography of published research into, and evaluations of, 3D immersive virtual worlds in Australian and New Zealand higher education will provide a solid platform for further research. Last but not least, an examination of the lessons learnt, including perceived and actual costs and benefits, support provided and barriers to use of the technology at the various institutions, will be invaluable in informing future applications and initiatives.

Details of the study

Aims and objectives

The scoping study primarily seeks to achieve a broad understanding of the current 'state of play' or 'lie of the land' of 3D immersive virtual worlds in the Australian and New Zealand higher education environment. Particular emphasis is being placed on university teachers', educational designers' and

information technology (IT) support staff members' perceptions and experiences relating to the use of the technology for learning and teaching. Specifically, the objectives of the study are to:

- compile a list of higher education practitioners who have explored the use of 3D immersive virtual worlds in their teaching;
- locate and document a range of examples of current, past or planned 3D immersive virtual worlds usage at the various institutions for learning and teaching purposes;
- examine the costs and perceived benefits for learning and teaching (as well as the actual benefits, where these have been evaluated);
- collate an annotated bibliography;
- identify the current level(s) of access to and support for 3D immersive virtual worlds afforded by the institutions to their students and staff, as well as any training provided in their use; and
- provide a forum for collating and disseminating lessons learnt by academics and institutions, both individually and collectively.

A secondary goal of the study is to outline the nature of, and reasons behind, actual and perceived barriers within institutions, and to assemble and disseminate advice on how academics and institutions can effectively overcome such barriers to promote successful adoption, uptake and use.

Overall, the project will assist in the facilitation of ongoing dialogue and exchange within a 3D immersive virtual worlds community of practice both among institutions involved in DEHub as well as in the educational technology and higher education communities more broadly.

Research design/methodology

The scoping study consists of three phases of data collection:

1. Literature searches and searches of institutional web sites for the purpose of compiling an initial database of higher education staff who have a known interest or involvement in using 3D immersive virtual worlds for learning and teaching;
2. An online questionnaire to elicit detailed information about the ways in which 3D immersive virtual worlds have been/are being used, and the perspectives of the teaching staff involved; and
3. Interviews to gather more detailed information and perspectives from a subset of questionnaire respondents.

Phase 1: Compilation of a 3D immersive virtual world user database (January to May 2010)
A list of 163 higher education staff members who use, have used or have considered using 3D immersive virtual worlds in their teaching has been compiled through literature searches, web searches and word-of-mouth networking. This database has provided an initial list of potential respondents to the questionnaire. The 163 identified staff members include 86 males and 77 females, with 116 staff based at Australian institutions and 47 staff based at New Zealand institutions.

Phase 2: Questionnaire (February to July 2010)
The questionnaire was developed using an iterative process, with initial drafts generated through discussions within the project team, followed by the trialling of key questions with potential participants using cognitive interviewing techniques (see, for example, Willis, 1999). A pilot version of the questionnaire was then produced using the *SurveyMonkey* online questionnaire delivery platform (http://www.surveymonkey.com/) and tested with the help of 10 participants, including members of the DEHub VWWG as well as other identified individuals with appropriate expertise. Based on feedback from this group a final version of the questionnaire was created.

The questionnaire included questions grouped into the following sections:

1. Demographic data including age, gender, institution, teaching discipline area, teaching experience and experience with 3D immersive virtual world platforms;
2. Views and beliefs about the potential of 3D immersive virtual worlds for learning and teaching;
3. Summary information about each subject/course/unit in which 3D immersive virtual worlds had been used including the years of offering, the discipline area, the virtual world platform used, the delivery mode, the number of students involved, whether the use of virtual worlds was compulsory and whether it was an assessable component of the subject/course/unit;

4. More detailed information about a single subject/course/unit in which 3D immersive virtual worlds were used; and
5. Key success factors and barriers to the use of 3D immersive virtual worlds in learning and teaching as perceived by participants, based on their observations and experiences.

As well as approaching individuals directly via email to invite them to participate, the questionnaire was made available through various electronic mailing lists/listservs and other distribution mechanisms. In particular, the questionnaire was publicised through the listservs and newsletters/bulletins of several associations, including ascilite, the Open and Distance Learning Association of Australia (ODLAA), the Higher Education Research and Development Society of Australasia (HERDSA) and the Distance Education Association of New Zealand (DEANZ). Similar announcements were distributed to the members of a number of national and international online communities with a specific interest in the use of 3D immersive virtual worlds in education, such as SLED (the Second Life Educators group) and AusSLERs (Australian Second Life Educators and Researchers). 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*).

At the time of writing (late June 2010), 71 participants had responded to the questionnaire. It is anticipated that there will be about 100 respondents altogether.

Analysis of the questionnaire data will be primarily descriptive to present a clear picture of the scope of applications of 3D immersive virtual worlds across the two countries; however, some inferential statistics will be employed in order to provide clarity when comparing the responses of various subgroups within the respondent population.

Phase 3: Interviews (August to October 2010)
From the list of questionnaire respondents, up to 24 people will be approached to be individually interviewed. These interviews will be semi-structured and approximately 30 minutes in duration. Interviewees will be asked to elaborate and expand on their views, experiences, observations and reflections in relation to the use of 3D immersive virtual worlds for learning and teaching as described in their questionnaire responses. They will also be encouraged and given the opportunity to discuss, in detail, the ways in which they have used and/or intend to use the technology in their teaching practice, along with the motivating or driving factors and pedagogic rationale underlying their instructional designs and decisions. It is anticipated that a cross section of participants from a range of institutions, including academics from various discipline groups, educational designers and IT support staff, will be interviewed. Some interviewees may also be given the opportunity to work with the project team to write up their use/experiences of 3D immersive virtual worlds as case studies, for inclusion in the final project report.

Dissemination

The outcomes of the scoping study will be published as a report, accessible via the DEHub web site. As well as reporting on the data collected during each of the three phases of data collection, the report will also include a comprehensive annotated bibliography of publications about the use of 3D immersive virtual worlds in higher education in Australia and New Zealand. Additionally, key findings will be shared with the educational technology and higher education communities through delivery of conference presentations and production of journal articles.

Preliminary results

The results presented in this paper are based on the 71 responses to the questionnaire received at the time of writing. They should be considered indicative only, given that one would normally expect the characteristics of early and late respondents to questionnaires to differ at least to some extent. Nevertheless, they provide a valuable initial snapshot of 3D immersive virtual world usage in higher education in Australia and New Zealand. The data chosen for reporting in this article are drawn from sections 1 and 3 of the questionnaire (as described above), that is, demographic data about the respondents and summary data about the particular subjects and courses in which 3D immersive virtual worlds have been used. Data from the complete set of questionnaire responses, including all sections of the questionnaire, will be published in the project final report and elsewhere.

Demographic information about initial respondents

The initial 71 respondents to the questionnaire included 36 males, 33 females, and two who did not specify their gender. It included five people in the 26-35 years age range, 22 in the 36-45 years age range, 32 in the 46-55 years age range and 10 in the 56-65 years age range, with two who did not specify. This is interesting because it supports, at least to some degree, the findings of Kennedy et al. (2009), for example, who argue that, contrary to assertions by some commentators on 'digital natives' (Prensky, 2001a, 2001b) and the 'Net Generation' (Oblinger & Oblinger, 2005), younger academics are not in fact more likely than older academics to use new technologies in their teaching. These results may, however, need to be considered in light of differences in the opportunities available to younger academics compared to older and more senior academics, for example less autonomy in subject and course design and less access to funding and support for technology and innovation projects.

The initial respondents included 52 from Australia, 15 from New Zealand, and four who did not specify the location of their institution. A total of 39 respondents indicated that they had actually used 3D immersive virtual worlds in their own teaching.

3D immersive virtual world usage trends

The 39 respondents who indicated that they had used 3D immersive virtual worlds in their teaching reported on a total of 66 individual subjects/courses/units in which they had used the technology, including 121 individual subject offerings. Figure 1 shows the distribution of these subject offerings over the past 10 years. There is a definite upward trend in usage, with offerings in 2008 (23) being more than double the number in 2007 (9), offerings in 2009 (36) increasing substantially again, and offerings in the first half of 2010 (35) already approaching those over the whole of 2009.
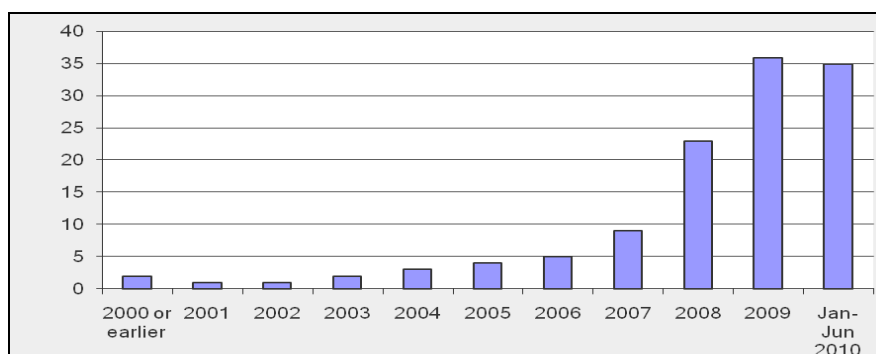

Figure 1: Distribution of subject offerings in which 3D immersive virtual worlds have been used over the past 10 years

3D immersive virtual world platforms

Figure 2 shows the 66 subjects in which 3D immersive virtual worlds were reported to have been used, broken down by virtual world platform. As expected, the vast majority of subjects using 3D immersive virtual worlds employed *Second Life* (49 or 79%), 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%). A number of other platforms were listed on the questionnaire but were not chosen by any respondents, specifically: *Vastpark*, *Multiverse*, *Worlds.com*, *Reaction Grid* and *web.alive*. Six respondents (9.7%) indicated that they had used another, unlisted platform. Of these respondents, one specified that he/she had used the *maidmarion* MMORPG (massively multiplayer online role-playing game), while the other five indicated that they had used worlds developed using one or more of the following: the *Neverwinter Nights* toolset, the *Torque* game engine, the *Unreal Tournament* game engine, *OpenGL*, *Blender* or the Virtual Reality Modeling Language (VRML).
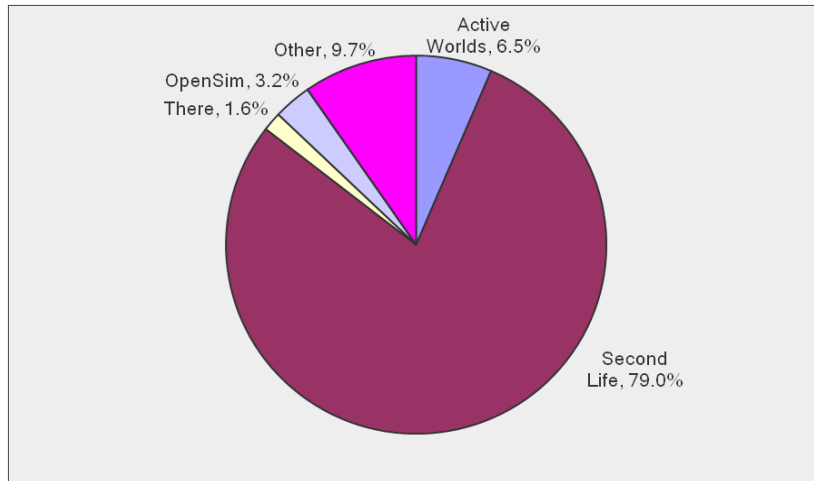
Figure 2: 3D immersive virtual world usage by platform

Delivery mode

Figure 3 shows the subjects in which 3D immersive virtual worlds were reported to have been used, broken down according to delivery mode. The majority of subjects reported to have used 3D immersive virtual worlds were delivered in face-to-face mode (43 or 66.1%), which may be reflective of the larger proportion of subjects across the sector delivered in this mode. Alternatively, this may indicate that the use of 3D immersive virtual worlds requires levels of instructional and technical support that make them difficult to use in non-face-to-face teaching.
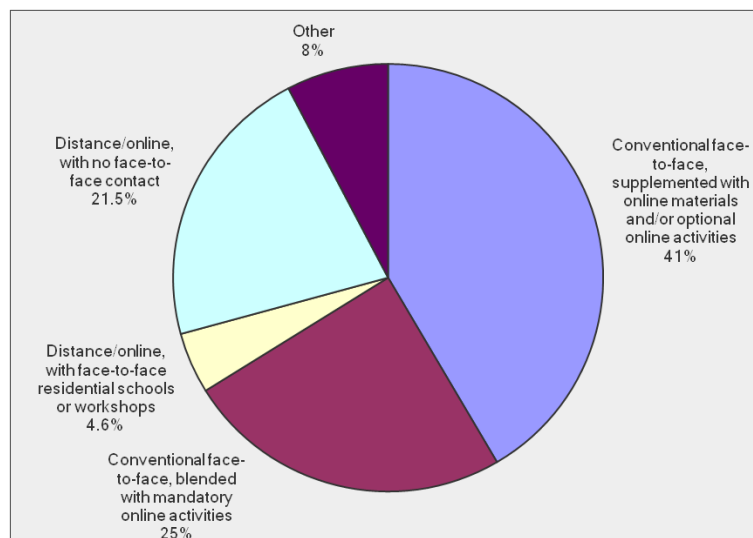
Figure 3: Subjects using 3D immersive virtual worlds by delivery mode

Role of 3D immersive virtual world tasks: Assessed or compulsory

Figure 4 shows the proportion of subjects in which 3D immersive virtual worlds were used, where the tasks were (i) compulsory and assessed (24 or 38.7%); (ii) compulsory and not assessed (12 or 19.4%); or (iii) neither compulsory nor assessed (26 or 41.9%). Arguably, the large number of subjects in which the offerings were neither compulsory nor assessed suggests that in many cases the use of 3D immersive virtual worlds is not yet a mainstream or core part of the subject.
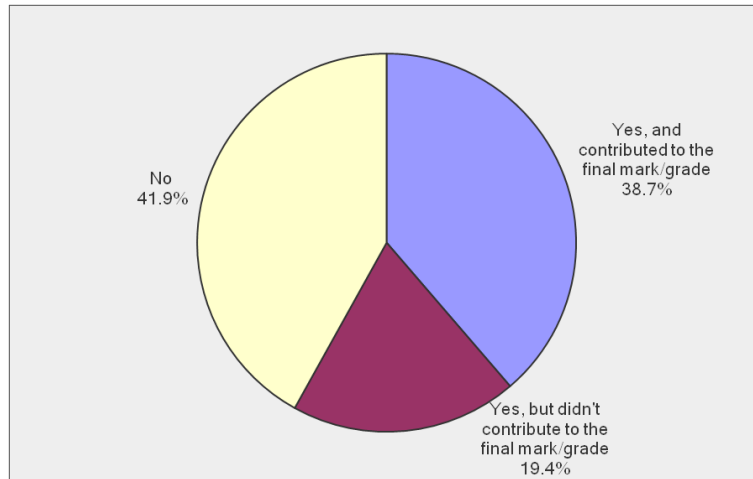
Figure 4: Subjects using 3D immersive virtual worlds by role of virtual world tasks

Subject or course discipline and level

Figure 5 shows the subjects in which 3D immersive virtual worlds were used, broken down by level of course. At this point in time, the data points to the fact that they are being used predominantly with undergraduate students. This could, of course, simply be because there are more students enrolled in undergraduate courses.
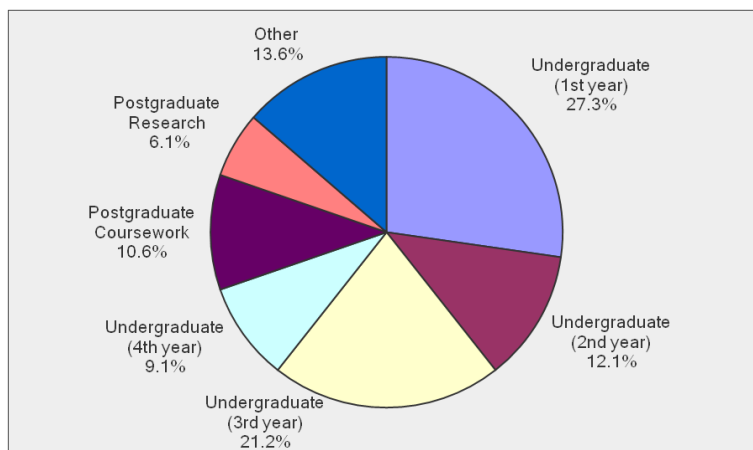

Figure 5: Subjects using 3D immersive virtual worlds by subject level

Figure 6 shows the subjects in which 3D immersive virtual worlds were used, broken down by discipline area. Participants were asked to name in their own words the discipline area of each subject, and the responses were then coded into the following categories:

- Education;
- Arts and Humanities;
- Science;
- Health Professional;
- Information Technology;
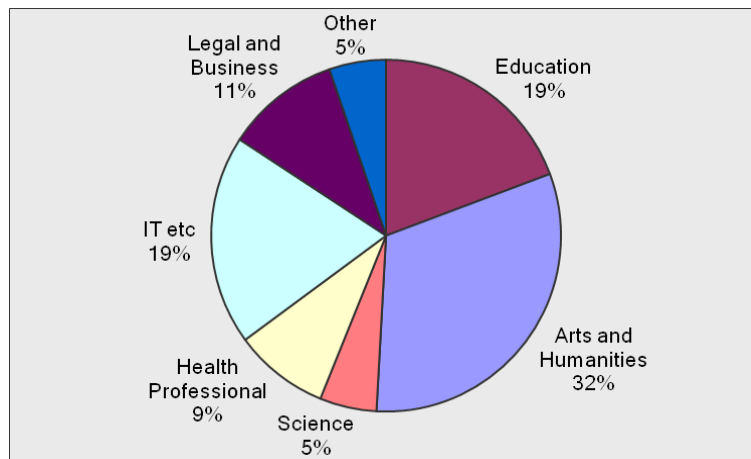- Legal and Business;
- Other.

Figure 6: Subjects using 3D immersive virtual worlds by discipline area

Discussion

The preliminary data presented in the previous section attest to the diversity of 3D immersive virtual world usage in higher education across Australia and New Zealand in terms of the virtual world platforms used, the role of virtual world tasks in relation to assessment, as well as the delivery modes, subject levels and discipline areas of the subjects involved. This diversity mirrors, in many ways, the findings of the JISC (de Freitas, 2008) and Eduserv (Kirriemuir, 2008) reports from the UK and the ECAR (Kelton, 2007) report from the US cited earlier. It can also be seen from the preliminary questionnaire data that there has been a clear overall increase from year to year of subject offerings in which 3D immersive virtual worlds have been used over the past decade.

Second Life is by far the most popular 3D immersive virtual world platform, reported to have been used by 79% of the questionnaire respondents in the partial data set used for the preparation of this paper. At the time of writing, Linden Lab, the proprietor of *Second Life*, has recently announced plans to dismiss one-third of its workforce (Linden Lab, 2010). Such occurrences, along with the demise of other competing platforms – such as, for example, *There.com* earlier this year (Wilson, 2010) – serve to point to and underscore the risks of over-reliance or dependence on a specific platform. Educators should take steps to ensure that in the event their chosen platform ceases to be available, the resources they have developed will be able to be easily ported or transferred to other, alternative platforms. Hopefully, pedagogical and instructional design lessons learnt will also be readily transferrable. Interestingly, the aforementioned Eduserv report claims that despite the fact that the use of *Second Life* in UK higher and further education is on the rise, "many academics are not 'welded' to it, being aware of its deficiencies and open to moving to alternative virtual environments, especially open source and more localised versions, in the future" (Kirriemuir, 2008, p. 2). The preliminary results of the scoping study also suggest that a noticeable proportion of higher education teaching staff and institutions across Australia and New Zealand are now developing custom or 'bespoke' virtual worlds and hosting them on their own servers and networks, willing to bear the higher costs and time commitment involved in exchange for greater levels of functionality, flexibility and control.

It is worth noting that 3D immersive virtual worlds and other desktop virtual reality environments have been in existence for over 20 years (de Freitas, 2008). They have been trialled and used in education long before the launch of *Second Life* in 2003, although the advent of the current generation of massively multi-user virtual worlds may have contributed to a resurgence of interest in the technologies and accelerated their uptake in education. Perhaps the learning affordances of these technologies (see Dalgarno & Lee, 2010) are valuable enough so that they will outlast any particular software platform or system; meanwhile, research is required to understand the precise nature of these affordances and how they can be exploited in pedagogically sound ways. Furthermore, there is a need to make time for awareness-raising, dialogue and professional development on what strategies, approaches, techniques and tools work best for achieving the desired learning outcomes, and to aid teaching staff in gaining the confidence and competence to integrate these successfully into their learning designs and teaching practices.

Conclusion and next steps

The substantial investments being made by higher education institutions and agencies in 3D immersive virtual worlds for learning and teaching call for large-scale, sector-wide efforts that seek to capture and document staff members' perceptions and experiences relating to the use of the technology, and that attempt to identify good and/or best practices in the area. The Australian and New Zealand 3D immersive virtual worlds scoping study supported by the DEHub research consortium targets this need through a systematic review and environmental analysis that parallels and complements studies conducted elsewhere in the world, particularly the UK and USA.

This paper has reported on the overall research design of the DEHub scoping study, in addition to presenting preliminary results drawn from the questionnaire phase of the study. Key points that have arisen at this stage are:

- data is in general consistent with international findings (UK and USA);
- there has been a dramatic increase in the use of 3D immersive virtual worlds in Australian and New Zealand higher education institutions;
- there is a diversity of virtual worlds in use, although *Second Life* appears to be the most popular platform;
- uptake by academics is predominantly by more mature individuals aged 46 years and older;
- 3D immersive virtual worlds are being used largely in face-to-face or blended learning (as opposed to fully online/distance) scenarios, and mostly at an undergraduate level; and
- half of the respondents were using the technology in the Arts, Humanities or Education disciplines.

The study will build on the preliminary results with further collection and analysis of quantitative and qualitative data related to higher education staff members' views and beliefs about 3D immersive virtual worlds for learning and teaching, their current and planned uses of the technology, and their observations and reflections on their experiences. Following the close of the questionnaire, selected respondents will be purposively sampled to participate in individual interviews in order to allow for more in-depth information and insights to be obtained. An important goal here will be to understand how the unique capabilities and affordances of 3D immersive virtual worlds are being exploited to deliver pedagogical benefits and outcomes in ways that would be difficult or impossible to achieve without the technology (see Dalgarno & Lee, 2010).

The final project report, which is due for release in early 2011, will include the complete results of the scoping study and incorporate a number of case studies of exemplary, innovative practice. These will be accompanied by an annotated bibliography of relevant publications and other useful resources.

References

Bradshaw, D. (2006). *Virtual worlds – real learning! Pedagogical reflections*. Brisbane: Australian Flexible Learning Framework.
http://virtualworlds.flexiblelearning.net.au/reports/VWRL_pedagog_reflect.pdf

Campbell, M. (2009). Using 3D-virtual worlds to teach decision-making. In *Same places, different spaces. Proceedings ascilite Auckland 2009*.
http://www.ascilite.org.au/conferences/auckland09/procs/campbell-m.pdf

Collins, C. (2008). Looking to the future: Higher education in the Metaverse. *EDUCAUSE Review*, 43(5), 51-63. http://www.educause.edu/ir/library/pdf/ERM0853.pdf

Dalgarno, B. & Lee, M.J.W. (2010). What are the learning affordances of 3-D virtual environments? *British Journal of Educational Technology, 41*(1), 10-32.

de Freitas, S. (2008). *Serious virtual worlds: A scoping study*. Bristol, UK: Joint Information Systems Committee. http://www.jisc.ac.uk/media/documents/publications/seriousvirtualworldsv1.pdf

Gamage, V., Tretiakov, A. & Crump, B. (2009). Educators' perceptions about using MUVE for teaching. In *Same places, different spaces. Proceedings ascilite Auckland 2009*.
http://www.ascilite.org.au/conferences/auckland09/procs/gamage-poster.pdf

Gregory, S. & Tynan. B. (2009). Introducing Jass Easterman: My Second Life learning space. In *Same places, different spaces. Proceedings ascilite Auckland 2009*.
http://www.ascilite.org.au/conferences/auckland09/procs/gregory.pdf

Henderson, M., Huang, H., Grant, S. & Henderson, L. (2009). Language acquisition in Second Life: Improving self-efficacy beliefs. In *Same places, different spaces. Proceedings ascilite Auckland 2009*. http://www.ascilite.org.au/conferences/auckland09/procs/henderson.pdf

Hew, K. F. & Cheung, W. S. (2010). Use of three-dimensional (3-D) immersive virtual worlds in K-12 and higher education settings: A review of the research. *British Journal of Educational Technology*, 41(1), 33-55. https://doi.org/10.1111/j.1467-8535.2008.00900.x

Johnson, L., Levine, A. & Smith, R. (2008). *The Horizon Report: 2008 Australia–New Zealand edition*. Austin, TX: New Media Consortium. http://www.nmc.org/pdf/2008-Horizon-Report-ANZ.pdf

Kelton, A.J. (2007). *Second Life: Reaching into the virtual world for real-world learning*. Boulder, CO: EDUCAUSE Center for Applied Research.
http://www.educause.edu/ir/library/pdf/ERB0717.pdf

Kennedy, G.E., Dalgarno, B., Bennett, S., Gray, K., Waycott, J., Judd, T., Bishop, A., Maton, K., Krause, K.-L. & Chang, R. (2009). *Educating the Net Generation: A handbook of findings for practice and policy*. Melbourne: University of Melbourne Press.

Kirriemuir, J. (2008). *A Spring 2008 'snapshot' of UK higher and further education developments in Second Life*. Bath, UK: Eduserv. http://www.scribd.com/doc/7063700/A-Spring-2008-snapshot-of-UK-Higher-and-Further-Education-Developments-in-Second-Life

Lee, M.J.W. (2009). How can 3D virtual worlds be used to support collaborative learning? An analysis of cases from the literature. *Journal of e-Learning and Knowledge Society*, 5(1), 149-158.
http://www.je-lks.it/en/09_01/3met_lee_ing09.pdf

Lee, M.J.W. (2010). *3D immersive virtual worlds in higher education: Emerging academic staff and student perspectives on learning and teaching in new online spaces*. Unpublished manuscript.

Linden Lab (2010). Linden Lab restructures to generate efficiencies and support investment in new platforms. http://lindenlab.com/pressroom/releases/06_09_10

New Media Consortium (2007). *The Horizon Report: 2007 edition*. Austin, TX: NMC.
http://www.nmc.org/pdf/2007_Horizon_Report.pdf

Oblinger, D.G. & Oblinger, J.L. (Eds) (2005). *Educating the Net Generation*. Boulder, CO: EDUCAUSE.

Prensky, M. (2001a). Digital natives, digital immigrants. *On the Horizon*, 9(5), 1-6.

Prensky, M. (2001b). Digital natives, digital immigrants, Part II: Do they really think differently? *On the Horizon*, 9(6), 1-6.

Rogers, L. (2009). Simulating clinical experience: Exploring Second Life as a learning tool for nurse education. In *Same places, different spaces. Proceedings ascilite Auckland 2009*.
http://www.ascilite.org.au/conferences/auckland09/procs/rogers.pdf

Willems, J. (2009). Different spaces but same places: Possibilities, pitfalls and persistent practices in Second Life. In *Same places, different spaces. Proceedings ascilite Auckland 2009*.
http://www.ascilite.org.au/conferences/auckland09/procs/fewster.pdf

Willis, G.B. (1999). *Cognitive interviewing: A 'how to' guide*. Research Triangle Park, NC: Research Triangle Institute. http://appliedresearch.cancer.gov/areas/cognitive/interview.pdf

Wilson, M. (2010). There.com closed on March 9th, 2010. http://www.there.com/info/announcement

Author biographies and contact details:

Barney Dalgarno, School of Education, Charles Sturt University, Locked Bag 588, Wagga Wagga, NSW 2678, Australia. Email: bdalgarno@csu.edu.au.

Barney is an Associate Professor of Educational Technology in the School of Education at Charles Sturt University. His research interests include the educational affordances of 3D virtual learning environments, the application of constructivist theories to technology facilitated learning design, critical exploration of the impact of generational changes on learners, learning and learning technologies and the use of functional brain imaging to explore interactivity and cognition. As well as being awarded a number of research and teaching grants, he has received national recognition through awards for innovative teaching and learning design using leading-edge technologies.

Mark J.W. Lee, School of Education, Charles Sturt University, Locked Bag 588, Wagga Wagga, NSW 2678, Australia. Email: malee@csu.edu.au.

Mark is an Adjunct Senior Lecturer with the School of Education at Charles Sturt University. He also concurrently serves as Adjunct Senior Lecturer with the DEHub research institute at the University of New England, as well as Honorary Research Fellow with the Graduate School of IT and Mathematical Sciences at the University of Ballarat. Mark has published widely in the fields of educational technology, e-learning and innovative pedagogy in higher education, with over 50 refereed publications to his name. His current research interests include pedagogical uses of Web 2.0, mobile learning, digital game-based learning and the use of 3D virtual environments for learning.

Lauren Carlson School of Education, Charles Sturt University, Locked Bag 588, Wagga Wagga, NSW 2678, Australia. Email: lcarlson@csu.edu.au.
Lauren Carlson is a Research Assistant with the School of Education at Charles Sturt University, and with the Research Institute for Professional Practice, Learning and Education (RIPPLE) at the same university. She is currently involved in research projects in the areas of mathematics education and the use of 3D virtual worlds for tertiary teaching and learning. Lauren holds a Bachelor of Education (Primary) from CSU, in which she graduated with first-class honours.

Sue Gregory, DEHub and School of Education, Faculty of The Professions, University of New England, Armidale, NSW 2351, Australia. Email: sue.gregory@une.edu.au.
Sue is a Lecturer in ICT in the School of Education as well as a Research Fellow with the DEHub research institute at the University of New England and Chair of the DEHub Virtual Worlds Working Group. She is responsible for training pre-service and postgraduate education students on how to incorporate technology into their teaching. Since 2007, through her avatar, Jass Easterman, she has been researching *Second Life* with her students with respect to the various learning opportunities that virtual worlds provide, and has been involved in many projects on the efficacy of virtual worlds.

Belinda Tynan, DEHub, Faculty of The Professions, University of New England, Armidale, NSW 2351, Australia. Email: belinda.tynan@une.edu.au.
Belinda is a Professor and Academic Director in the Faculty of the Professions at the University of New England, and also Director of the DEHub research institute. Additionally, she directs *Project 2012*, the University's strategic initiative on flexible and online learning. Belinda has held numerous teaching positions in the UK, Australia and Japan, and has demonstrated experience in the management of large projects in the higher education sector, both in Australia and overseas. Her research covers a range of areas such as music teaching, distance education, academic staff development and collaboration.