Virtual World Adoption in Tertiary Education: A Review of Literature

Kimberley Tuapawa
Eastern Institute of Technology
Napier
ktuapawa@eit.ac.nz

David Skelton
Eastern Institute of Technology
Napier
dskelton@eit.ac.nz

ABSTRACT

This is a review of the literature surrounding virtual world (VR) technology and its utilisation within tertiary environments. The factors that contribute to its adoption by a tertiary environment are examined through an evaluation of the features, benefits, challenges and resolutions. Conclusions about its future potential are also outlined in the light of the New Zealand Governments' intention to bring Ultra-Fast Broadband (UFB) to schools and 90% of businesses by 2015.

The key features of this technology, those which hold relevance in a tertiary environment include the opportunity for richer real-time interaction, unique experiential learning scenarios, wider reach across remote regions, and learnable interactive interfaces. The key challenges of this technology include the constraints on broadband, limitations of current technologies, high costs to implement required infrastructure and negative preconceptions. Resolutions to these challenges include the inauguration of Ultra-Fast Broadband, the adaptive and ever-improving nature of modern technologies, having a good business case and management support, and clarification of misunderstood aspects of virtual world technology.

The outcomes of this review provide: 1) an insight into how this technology operates and how it is being utilised within a tertiary environment, 2) a glimpse into the future potential and capability of this technology, and 3) a contribution to the growing field of research in VR, championed by notable groups within the Pacific and Australasian regions, including SLENZ, BlendSync and DEHub Virtual Worlds Working Group.

Keywords

Virtual world, virtual world technology, virtuality, synchrony, collaboration, co-presence, tangibility, immediacy, scalability, three-dimensionality, adaptability, immersion, experiential, engagement, broadband, ultra-fast.

1. INTRODUCTION

The emergence of virtual world technology has created a significant level of interest in the value and utilisation of virtual learning systems in tertiary environments. With the potential to create new pathways, contribute to innovation and expand learning and teaching opportunities, educators worldwide are seeking to 'exploit the affordances of these rich-media real-time collaboration tools' (Lee, 2009, p. 149). It is thus useful to consider the factors that contribute to its implementation within a tertiary environment. This can be done by evaluating four key areas relevant to the adoption of VR; these are the: 1) features, 2) benefits, 3) challenges and 4) resolutions. It is also useful to consider how the capability of this technology may expand in light of the New Zealand Governments' intention to bring Ultra-Fast Broadband (UFB) to schools and 90% of businesses by 2015.

For the purpose of this review, the term *virtual world technology* refers to the systems and technology in place to facilitate a virtual world environment. The term *virtual world* can be defined as a three-dimensional computer-generated world representation, having a basis in reality or fiction, in which user-controlled avatars (three-dimensional humanoid or non-humanoid beings) exist with a level of interactive ability.

The key features of this technology, in particular those relevant in a tertiary environment, are identified as: synchrony, collaboration, co-presence, tangibility, immediacy, scalability, graphical three-dimensionality, wide reach, adaptability, agency, immersion, experientiality, and engagement. Each of these features is defined in *virtual world* terms, and the benefits are outlined from an examination of the literature.

2. VIRTUAL WORLD FEATURES

2.1 Synchrony

Within a virtual world, synchrony enables users to exist, move, communicate and interact at the same time, or synchronously. The ability to synchronise means that within a virtual world two or more users can jointly and synchronously undertake academic, kinesthetic or tactile activities (Lee, 2009).

The results from a series of e-learner interviews undertaken in a study comparing asynchronous and synchronous learning revealed that "many e-learners felt that synchronous communication was "more like talking" compared with asynchronous communication" (Hrastinski, 2008, p. 54). Synchronous communications were more appropriate and acceptable for exchanging social support and discussing less 'complex' issues. With synchronous communications e-learners felt more psychologically aroused and motivated, as it more closely resembled face-to-face communication (Hrastinski, 2008). "With the synchronous model, various real-time activities can be carried out, providing continuous motivation for students. In addition, as compared to the asynchronous model, synchronous online learning promotes a sense of community between the students and teachers" (Business-Software.com, 2012, p. 1).

2.2 Collaboration

The collaborative ability within virtual world technology has enabled participation by individuals across disciplines, institutes and borders. Empirical studies indicate that collaboration within a virtual world contributes to higher levels of in-class dynamicity. After teaching nine university courses, Professor Calongne from Colorado Technical University, commented on how collaboration within a virtual world promotes an experience that is "lively, engaging and rich with social networks, interaction, and expression" (Calongne, 2008, p. 1).

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The Virtual Worlds Working Group (VWWG), stated in a case study and analysis of 21 Australian institutions utilising virtual worlds that the simulative characteristics of the virtual world encouraged greater sharing of ideas and collaboration in a more engaging online medium. (Gregory et al., 2010). The nature of online collaboration is that it also conserves physical space and alleviates the issues arising from "cramming a room" with those who are more likely to disengage (Strickland, 2012, p. 1).

2.3 Co-presence

Within a virtual world, co-presence enables users to be present and 'see' each other at the same time. Being present in the same virtual location means that geographically dispersed users can explore an environment concurrently, be visible to other users and enjoy the distinct communicative advantages and rich emotive displays that virtual worlds can achieve (Lee, 2009).

The ability to sense the presence of the instructor and other students increases the likelihood of real-time communications that involve discussion on broader and interpersonal issues such as work, family and events. "These planned and serendipitous interactions are key as students move from novice to expert... in terms of being able to work collaboratively with other professionals" (Bronack et al., 2008, p. 61).

2.4 Tangibility

Within a virtual world, tangibility refers to the quality of an object or individual being material or substantial and matching that which has a basis in reality, that which is tangible. The quality of tangibility affords a richer and more meaningful exchange, enabling the capture and portrayal of facial expressions and body language. In a review focusing on how three-dimensional (3D) virtual worlds can be used to support collaborative learning, Lee (2001) stated that avatar-avatar interaction was considered richer than two-dimensional (2D) alternatives because it enabled users to motion directions, point out virtual objects and use the positioning and orientation of their avatars as reference points when referring to objects. The 'see and touch' element of tangibility provides distinct communication advantages over text based tools (Lee, 2009).

2.5 Immediacy

Immediacy refers to movements, actions or observations that an individual instantly sees or does. In an article presenting the concept of immediacy, Woods stated that "active ongoing communication is likely to result in an increased feeling of psychological closeness between the learner and instructor" and that "the presence of such immediacy is likely to promote increased levels of interaction because learners and instructors are developing a safe and rich interpersonal environment" (Woods Jr, 2004, p. 1).

The VWWG stated, upon analysis of the virtual world island set up by Monash University, that "the interaction is semi-naturalistic…there is a degree of unpredictability built in that requires learners to engage in authentic cognitive activity, that is, they have to think on their feet in a way that is not dissimilar to similar real-life situations" (Gregory et al., 2010, p. 402).

2.6 Scalability

Within a virtual world, scalability refers to the system's ability to extend or expand physically to accommodate more activity. The ability to increase or decrease scale enables the enlargement of infrastructure to house increased class sizes, physically extend lecture theatres, laboratories and libraries. Significant technological implications must be considered in achieving effective levels of scalability, such is discussed in the resolutions (to technological constraints) later in this paper.

2.7 Graphical three-dimensionality

Graphical capabilities refer to the capabilities and visual communications inherent to 3D graphical interfaces. 3D modeling and animation can "simplify complicated concepts and convey complex inter-relationships, which are difficult to visualize. Concepts and ideas, which cannot easily be represented in words or even through illustrations, can be easily created and viewed from different angles" (Orient Info Solutions, 2012, p. 1). The three dimensional aspect generates a realistic, believable experience and spatial understanding.

2.8 Wide reach

Wide reach refers to the extent to which this technology can be utilised over a geographically dispersed area. Virtual worlds enable presenters to conduct sessions from anywhere in the world and for students from different locations to collaborate in a shared virtual space (Gregory et al., 2010). Increasingly tertiary-level students have expectations that their learning will be accessible from outside a campus. The VWWG stated in regards to virtual learning at Charles Sturt University that "virtual worlds are opening up new possibilities and creating exciting opportunities...with 75% of the university's students studying in distance or mixed modes" (Gregory et al., 2010, p. 407).

2.9 Adaptability

Within a virtual world, adaptability refers to the way in which objects, environments and methods can change to suit a need, or adapt to it. Understanding the adaptive nature of virtual worlds enables educators and their pupils to think beyond the square, to envision how this medium should accommodate or flex to learning needs. "Virtual worlds offer the foremost in ...adaptability", providing the opportunity to tailor environments to "ensure realistic interaction and imagery" which promotes full "emotional and intellectual engagement in any scenario" (Visual Purple, 2012, p. 1).

2.10 Immersion

Immersion refers to users feeling 'a part of' or being mentally absorbed in the experience of being within a virtual world activity. Virtual worlds provide a "rich, immersive, collaborative environment" for learning activities (Salt, Atkins & Blackall, 2008, p. 11). A study focused on the work being undertaken in virtual world education by a number of New Zealand institutes of higher learning reported that the students working in virtual worlds demonstrate a high level of immersion in the tasks (Hearns et al., 2011). Immersion increases meaningful interaction for students operating within a virtual world environment.

2.11 Experientiality

Experientiality refers to learning and understanding through physically observing or engaging in a task through an agentic mode. The VWWG states in regards to the virtual world learning at Swinburne University of Technology, that students are able to "interact with real time people and life events whist exploring the usage of space, such as how customers are treated as part of a space rather than just a visitor on a website" (Gregory. et al., 2010, p. 403). Virtual worlds are ideal vehicles for andragogic experiential learning (Salt, Atkins & Blackall, 2008). Experiential learning within a virtual world enables students to benefit from being "exposed to different ways of learning, not only books or

lectures, but by more practical and immersive ways" (Gregory et al., 2010, p. 403).

The use of virtual worlds opens up "opportunities for visualisation, simulation, enhanced social networks, and shared learning experiences", leveraging "a mix of content and activity to support" all learning styles, "auditory, visual, and kinesthetic" (Calongne, 2008, p. 1).

At the University of Sydney, a "3D virtual surgical ward populated with simulated patient avatars for students" was established to "provide students the opportunity to rehearse dealing with problem based presentations of surgical disease" (Gregory et al., 2010, p. 404). The experiential nature of 'learning without real-life consequences' contributes to a reduction of emotional pressure experienced by learners. Virtual worlds play an important role in enabling an imitation of real life without the risk, reducing performance anxiety and students with a disability to increase confidence, participation and 'doing' (Winter, 2010).

The simulative aspects of virtual worlds provide a rich tapestry of experiential opportunities for educators by enabling the addition of lifelike contexts to learning and the ability to contextualise otherwise abstract and dry education principles (Gregory et al., 2011).

2.12 Engagement

Within a virtual world, engagement refers to learning and participation in online activity through agency. The VWWG found that many institutes utilising virtual world learning reported increased engagement of students, an observation...reflected in increased participation, increased interaction and a greater willingness to share. Virtual worlds contribute to an increased sense of being there, resulting in an increased student perception of their engagement. (Gregory et al., 2011) In the SLENZ project "both learners and educators recognised the powerfully engaging aspect of the virtual world used" (Winter, 2010, p. 1).

3. VIRTUAL WORLD CHALLENGES

The challenges of this technology, in particular those which hold relevance in a tertiary environment, are identified as: constraints on broadband, limitations of current technologies, high implementation and infrastructural costs, lack of senior management support and negative pre-conceptions to this technology. Possible resolutions to these challenges are drawn using supportive research material.

3.1 Bandwidth Constraints

The physical constraints in bandwidth are a significant impediment to virtual worlds (Gregory et al., 2011). In the SLENZ project, both staff and students experienced technical challenges due to low levels of bandwidth. The application was 'bandwidth hungry' resulting in an experience marred by related difficulties (Winter, 2010).

This challenge may be mitigated or resolved through improved connectivity through the inauguration of Ultra-Fast Broadband. The New Zealand government's objective is to accelerate the roll-out of UFB to 75 percent of New Zealanders over ten years. UFB will provide downlink speeds of at least 100 Megabits per second (Mbps) and uplink speeds of at least 50Mbps. (Alcatel-Lucent, 2010) "The Government's Digital Economy Goal for Expanded Online Education is that, by 2020, Australian…higher education institutions will have the connectivity to…extend the opportunity for online virtual learning" (Australian Government, 2012, p. 4).

3.2 Limitations of current technologies

The physical constraints of computer hardware are significant impediments to virtual worlds. In the SLENZ project, users experienced a significant level of technical issues, emerging from firewall issues, broadband usage, computer specifications and soundcard installation problems (Winter, 2010).

This challenge may be mitigated or resolved through the adaptive and ever-improving nature of modern technologies. In a paper designed to promote awareness of a large-scale project focused on media-rich synchronous technologies, including virtual worlds, the authors comment on how media-rich synchronous technologies have emerged and may be used to greatly enhance the educational experiences of increasingly distributed students (Bower et al., 2011).

Some members of the VWWG reported that to enable better access for on-campus students, they upgraded computer equipment in laboratories. (Gregory et al., 2011).

The exploration of emerging technologies is often done with a view to meeting future needs and developments. "Given the future will undoubtedly see faster, cheaper computers, faster national and global connectivity and bigger and better resolution screens, the application of virtual world technologies to the fields of education, business and entertainment can only increase. "Universities need to increase their rate of use and acceptance of digital technologies otherwise they run the risk of being sidelined. Virtual worlds open opportunities for students to construct new ways of being and exploring knowledge. Portals of the virtual world are now surpassing the doors of the traditional university" (Gregory et al., 2010, p. 410). Limitations such as computer access and lag will lessen as the technology improves over time (Wankel & Kingsley, 2009).

3.3 High Implementation Costs

Another challenge is the high cost associated with implementing the required infrastructure. "While membership of many of the virtual worlds used by educators is free, there are costs associated with the purchase and maintenance of virtual space on many public servers" (Gregory et al., 2010, p. 410). In general however, the cost of technology decreases over time. A good business case and management support is important to securing funding to implement the required infrastructure.

3.4 Lack of technical and management support

Any implementation will require a significant investment and approval from executive level. It is perhaps the demonstrable lack of this level of buy-in which is proving more of a barrier for institutions than any other (Wankel & Kingsley, 2009).

This challenge may be mitigated through good project management techniques and effective communications to secure senior management and technical support. Support from senior management has assisted academics in securing the resources to provide virtual world experiences to their students and other staff. In certain cases, it has become clear that when technical support was available during the initial stages many issues were overcome (Gregory et al., 2011).

In the SLENZ project users felt it was important to establish champions at a senior level and advisable to involve the institution's IT departments from an early stage, and in some cases to prepare a business case to ensure the necessary support. The contextual and content knowledge that educators have needs

to be communicated to the developers in order that the virtual worlds they build meets the intended purpose (Winter, 2010). Good communications with technical support groups are paramount to the successful implementation...in terms of both the provision of suitable hardware (from graphics cards through to good quality headsets for voice communication) and ensuring that access through the opening and monitoring of the required ports is unhindered (Wankel & Kingsley, 2009).

This challenge may also be mitigated or resolved as confidence in utilisation of virtual world technology grows within management. There has been a dramatic increase in the utilisation of 3D immersive virtual worlds in both Australian and New Zealand higher education institutions, proof of increasing support for the use of this technology (Dalgarno, Lee, Carlson, Gregory & Tynan., 2011).

The VWWG comments that many higher education institutes are "responding to the opportunities to harness virtual worlds by demonstrating innovative uses of technology to adapt or transform the curriculum for future needs of learners and teachers" (Gregory et al., 2010, p. 400). Many higher educational institutions operate their own islands or parcels of land in Second Life (Gregory et al., 2010). The opportunities for synchronous group participation and collaborative online efforts will continue to grow and develop (Wankel & Kingsley, 2009).

"Educators are exploring the potential of 3D virtual worlds to support a wide range of activities including virtual seminars, experiential learning, supporting synchronous learning for distance learners virtual field trips, role plays and simulations, problem solving, design and construction and to facilitate awareness of ethical issues and intercultural considerations" (Gregory et al., 2010, p. 400).

This challenge may also be mitigated or resolved due to the highly dynamic, evolving higher education context. The number of subject offerings in which 3D immersive virtual worlds have been used has increased over the past decade (Dalgarno et.al. 2011).

Educational demands in New Zealand are changing rapidly, and a number of tertiary institutes New Zealand are already using virtual world technologies in response to these demands with stated outcomes such as "engaged students, retained students, increased collaboration" (Hearns et al., 2011, p. 572). The younger generations will be seeking placements at universities with the expectation of utilising this technology for learning (Wankel & Kingsley, 2009).

3.5 Negative pre-conceptions

Another challenge is the negative pre-conceptions of this technology. In the SLENZ project staff expressed resistance to the use of the virtual world in their programmes, feeling cynical about the Internet. The questionable activities known to have taken place in Second Life have resulted in a perceived "sleaze factor" and the opinion that the virtual world is populated by sexual perverts (Winter, 2010). Media coverage appears to have informed the vocabulary of many of the negative comments (Wankel & Kingsley, 2009).

This challenge may be mitigated or resolved by providing clarification to misunderstood aspects of virtual world technology. Research is required to understand the precise nature of these affordances, and how they can be successfully exploited in a pedagogically sound way. There is a need to raise awareness and aid teaching staff in gaining the confidence and competence for integrating these technologies into pedagogical practice (Dalgarno et al. 2011).

Outcomes from research projects, such as 'Blendsync' will lead to greater understandings about how media-rich real time learning technologies, including virtual worlds, can be applied in a range of contexts across the higher education sector. This particular project will seek to increase the capacity of staff to use these technologies effectively in connection with pedagogically sound learning designs. Besides delivering practical value, the project will leverage, build on and extend scholarly knowledge in a number of areas related to learning, teaching and technology, focus on ways in which media rich synchronous technologies can be effectively used to engage lecturers and students in real-time learning regardless of where they are situated (Bower et al., 2011).

These resources will contribute to the development of staff capability in the domain of media-rich synchronous learning, thereby engendering improvements to their practice. The outcomes of the project will enable teachers to better understand how important characteristics of synchronous technologies can impact upon learning processes, enabling them to more effectively meet the learning needs of their students (Bower, Kennedy, Dalgarno, Lee, 2011).

In the SLENZ project, it was important to provide a thorough, compulsory, orientation to the virtual world (Winter, 2010). Learning the necessary computer skills, overcoming techno-anxiety, and developing effective strategies for managing specific characteristics of the technology are important for increasing communication competence (Wankel & Kingsley, 2009).

3.6 Ultra-fast Broadband

The government's objective is to accelerate the roll-out of UFB to 75 percent of New Zealanders over ten years. Essentially this means that schools, hospitals and 90 percent of businesses will be connected by 2015. Homes and the remaining 10 percent of businesses will be connected by 2019. Fibre will be capable of providing downlink speeds of at least 100 Mbps (megabits per second), and uplink speeds of at least 50 Mbps (Alcatel Lucent, 2010).

The availability of high-speed broadband will open up application-development possibilities, with more interactive online opportunities emerging as a result of being able to process higher amounts of data more quickly. New arrays of virtual services are likely to develop. Broadband deployments around the world have shown that as end-users and application developers become more familiar with the capability of broadband, they demand novel, innovative applications that specifically address their needs (Alcatel Lucent, 2010). This will be true in the case of tertiary education where end-users become more familiar with the capabilities of virtual learning and demand better or expanded utilisation of virtual world technology. UFB will provide tertiary educators and students with improved access to virtual learning resources and communications such as classrooms, practical scenarios, and other academic or social practices which will expand their capacity to better meet learning needs.

4. CONCLUSIONS

Virtual world technologies continue to generate a significant level of interest amongst tertiary educators. Considering the features, benefits, challenges and resolutions of incorporating virtual world technologies into a tertiary learning environment helps inform, engage and expand the horizons of educators who seek to effect a more innovative and responsive tertiary learning environment.

Virtual world technologies are likely to become part of an overall blended learning model for tertiary institutes. Current blended models would include face to face, video conferencing, Adobe Connect, enhanced learning management systems augmented by virtual world activities. Further research by the authors will attempt to place VR within a blended learning environment model.

As technology improves and as educators grow in their usage and understanding of virtual world technologies, the potential for overcoming the current challenges to incorporating this technology shall be resolved. As technology improves so too will the ways in which implementation is undertaken and utilised. In particular, the inauguration of UFB within New Zealand will expand its current capabilities and improve support for richer interactivity and effective learning experiences.

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