

Use of media-rich real-time collaboration tools for learning and teaching in Australian and New Zealand universities

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This paper provides an overview of media-rich real-time collaboration tool use for learning and teaching in Australian and New Zealand universities. These tools, which include video conferencing tools, web conferencing tools and virtual worlds, afford students and teachers the ability to synchronously represent concepts, and enable them to interact with one another to negotiate meaning and develop a sense of connectedness. A survey of 750 higher educators revealed that while desktop video conferencing and web conferencing use display an upward trend, virtual worlds are being used by substantially fewer educators, and have recently begun to experience a decline in usage. There are four major web conferencing products being used, whereas desktop video conferencing and virtual worlds are each being dominated by a single product. The 'best' uses of each technology as perceived by respondents with experience in a range of tools are examined, before the paper concludes with a discussion of implications for tertiary learning and teaching, along with an outline of the authors' future plans.

Keywords: video conferencing, web conferencing, virtual worlds, rich media, synchronous

Introduction

The study schedules of today's Australian and New Zealand university students typically have to compete with their intensive work, family and social commitments (James, Krause & Jennings, 2010). As a consequence, many students are finding it increasingly difficult to attend university campuses on a regular basis (Gosper, Green, McNeill, Phillips, Preston & Woo, 2008). In order to cater for these students, universities have turned to a range of online learning technologies, including enterprise learning management systems, such as *Blackboard*, *Moodle* and *Sakai*, as well as externally hosted Web 2.0 tools, such as *YouTube*, *Facebook* and *Wikispaces*. These technologies provide students studying in distance mode, as well as those enrolled in on-campus mode but not able to regularly come to classes, with access to resources like reading materials, lecture recordings and podcasts and give them the ability to communicate asynchronously with their lecturers and peers. However, these students miss out on the real-time collaborative learning opportunities availed to their face-to-face counterparts.

Media-rich real-time collaboration tools have the potential to help address this issue. Such tools, which include video conferencing tools (e.g. *Skype*), web conferencing tools (e.g. *Adobe Connect*, *Wimba*, *Blackboard Collaborate*) and virtual worlds (e.g. *Second Life*), are increasingly being used to bring together on-campus and

geographically dispersed students, and are arguably already providing remote tertiary students with unprecedented flexibility to participate in on-campus collaborative learning activities. Stewart, Harlow and DeBacco (2011) believe these contemporary technologies are able to offer universities new solutions to existing problems, such as preparing students for the 21st-century workplace, attracting students to university (especially underrepresented populations of students) and providing opportunities for leader/expert collaboration. Initiatives such as the Australian National Broadband Network will only serve to increase the quality of experience and prevalence of media-rich synchronous tool usage.

There is a range of somewhat outdated and speculative data on media-rich real-time collaboration tool usage. US research on distance education courses identified that only 23% of courses used two-way interactive video and 31% used synchronous Internet-based technologies (Parsad & Lewis, 2008). Researchers in the Australian context acknowledge that while media-rich technologies that facilitate interactive communication between users synchronously or asynchronously offer great promise to enhance student–student and student–teacher communication, they are not as widely used as they could be (Smyth, Andrews, Bordujenko & Caladine, 2011). Because the literature in the area is, to a large degree, uncharted and unorganised, universities are tending to work in isolation – often without an understanding of current practice in other institutions, and with unnecessary duplication of effort – to make technology usage and selection decisions.

This paper presents selected findings from a 2011-2012 Australasian survey investigating the use of media-rich real-time collaboration tools in higher education, with the goal of offering a reference point for the selection and deployment of such tools. An up-to-date understanding of media-rich synchronous technologies and how they can be used enables educators to support contemporary learning and teaching approaches as well as become more innovative pedagogical leaders into the future. This research has been undertaken as part of a project funded by the Office of Learning and Teaching (previously the Australian Learning and Teaching Council) aimed at investigating how media-rich real-time collaboration tools can be used to synchronously bring together remote and face-to-face students (Bower, Kennedy, Dalgarno & Lee, 2011). Please refer to the *Blended Synchronous Learning* website at <http://www.blendsync.org/> for more details about the broader project.

Media-rich real-time collaboration tools and their use in higher education

There are three main types of technologies that educators can use to offer media-rich synchronous learning experiences to remote and face-to-face students: video conferencing, web conferencing and virtual worlds.

Video conferencing

Video conferencing systems allow for synchronous audio and video feeds to be transmitted between sites so that each user or group of users can see and hear the other users. Traditionally, dedicated room or lecture theatre-based systems were required, and such systems have been used for some time to simultaneously deliver lectures to students based at multiple campuses. More recently, desktop video conferencing applications such as *Skype* have become available that allow for live audio and video interactions between remote participants using webcams and microphones attached their desktop or laptop computers. Such systems have gradually introduced additional tools, such as instant messaging, file transfer and sharing of desktop computer images.

The use of video conferencing is largely underpinned by the premise that “visual signals improve human interaction” (Fullwood & Doherty-Sneddon, 2006, p. 168). Video conferencing can facilitate informal communication, unplanned interactions at distance and an arrival at shared understanding by participants (Parker & Joyner, 1995). Students appreciate how video conferencing can reduce commute time and increase real-world skills (Koenig, 2010). Video conferencing provides an effective way to promote a sense of connectedness with overseas students as universities compete to internationalise their programs (Kan, 2011). Stewart et al. (2011, p. 358) contend that “productive learning occurs through conversations among students and faculty who create knowledge together, in real-time, without [necessarily] physically being together in the same place”. A variety of communicative patterns are possible with video conferencing, among which are ‘voice switching’ (a ‘free-for-all’ situation in which the ‘floor’ is passed to the person speaking at a given moment) and ‘chairing’ (where the ‘floor’ is allocated to an individual by the chair of the meeting) (Parker & Joyner, 1995). Where faculty were good communicators and able to keep students involved, the classes were deemed to be “equally as engaging as traditional classroom delivery” (Koenig, 2010, p. 2).

Web conferencing

Web conferencing tools allow groups of users to enter a shared online space where they can use features such as whiteboards, screen sharing, chat, voting, file sharing and collaborative authoring facilities together in real-time from within their web browsers. Almpans, Miller, Ross, Price and James (2011, p. 317) describe synchronous web conferencing environments as a “virtual classroom” and “the digital version of a classroom meeting” (p. 317). Interaction is facilitated through different modalities such as text chat, audio streaming, video streaming and desktop sharing (Steed & Vigrass, 2011). Typical functionalities include the ability to display PowerPoint presentations, broadcast webcam video and voice, exchange files, vote, write shared notes, and collaboratively draw on a whiteboard (Bower, 2011). Screen sharing to display visual materials can considerably enhance the learning experience (Steed & Vigrass, 2011). Social presence and responses are facilitated by a variety of emoticons and voting features providing a mix of communication and participant management modes, with multiple group work instances supported by ‘breakout’ rooms (Todhunter & Pettigrew, 2008). There has been a gradual merging of functionality between web conferencing and desktop video conferencing systems, so that many of the features of one are now also found in the other.

The use of web conferencing systems is a response to the general need to engage students with rich and/or synchronous online learning settings (Spanier, 2011). Web conferencing creates opportunities for geographically dispersed peers or colleagues to communicate across space (Reushle & Loch, 2008). There is growing evidence of cohesive strategies to develop web conferencing approaches within and across institutions. In Norway, the *Adobe Connect* web conferencing platform has been made available to all educational providers through Uninett, the Norwegian Education Institutional Network. Proponents of web conferencing argue for broad and strategic adoption within universities that maximises potential benefits to the institution and avails students and staff lasting open access (de Groot, Harrison & Shaw, 2011). Notwithstanding the increased uptake and use of these tools in recent years, there remains a need for a deeper and more nuanced understanding of how to make use of them in pedagogically sound and effective ways (Munkvold, Khazanachi & Zigurs, 2011).

Virtual worlds

Virtual worlds are online representations of physical environments in which users can move around and interact with other objects and users, usually in three dimensions. Virtual worlds permit rich actions and interactions, including the ability for users to exchange messages and objects with other users, see one another’s avatars interacting with the environment, and ‘experience’ the world through touch, voice communication and engagement in quests (Messinger, Stroulia & Lyons, 2008). Hew and Cheung (2010) note the three defining features of virtual worlds reported in the literature and add a fourth. The first three include ‘the illusion of 3-D space, avatars that serve as visual representations of users and an interactive chat tool for users to communicate with one another’ (Dickey, 2005, cited in Hew & Cheung, 2010, p. 34). The fourth important feature adds the ability for a user to ‘act’ on the world by using object properties in the virtual world and, by implication, enable learning by doing rather than by listening or reading a possibility for students (Hew & Cheung, 2010). As well as free navigation in a first-person perspective, virtual worlds also provide natural semantics in the place of symbolisms, and the ability to vary physical size to experience micro or macro environments that are beyond the normal human range (Mikropoulos & Natsis, 2011).

Virtual worlds afford learning tasks that can lead to enhanced spatial knowledge representation and increased intrinsic motivation and engagement as well as learning that is experiential, contextualised and collaborative (Dalgarno & Lee, 2010). Lim (2009) has proposed a ‘Six Learnings’ framework that highlights the breadth of potential learning designs that can be instantiated in virtual worlds, including exploration, collaboration, role-play, building, championing and expressing. The digital replication of real experience creates immersive presence that can give rise to learning through situated experiences and multiple perspectives, thus leading to greater transfer of learning to other contexts (Dede, 2009). The ability to provide different levels of structure and scaffolding for tasks enacted in virtual worlds gives teachers a degree of pedagogical control (Jacobson, Kim, Miao, Shen & Chavez, 2010). While there are issues associated with the integration of virtual worlds in a higher education setting, including a range of technical, cultural, interactional, economic, scheduling, standards, scaffolding persistence, social and identity-related issues (Warburton, 2009), the overwhelming majority of virtual world educators found using virtual worlds positively impacted on their students’ learning (Dalgarno, Lee, Carlson, Gregory & Tynan, 2011b).

The literature relating to the use of media-rich real-time collaboration tools such as desktop video conferencing, web conferencing and virtual worlds is not only fragmented between these sub-areas, but also within them. It is difficult to find data that present an overview of the different sorts of tools that are being used and the relative

prevalence of each. The current survey was conducted in 2011-2012 to address this gap, particularly with respect to the Australian and New Zealand higher education sector. This paper shares results of the survey to document how educators in Australian and New Zealand universities use media-rich real-time collaboration tools, the particular tools they are using, and their perceptions of the ways in which these tools are best used.

Method

Materials

The survey designed for this investigation contained three substantive sections. The first section included general demographic questions as well as items relating to years of experience in teaching, in using computers and the Internet for teaching, and in teaching using media-rich real-time collaboration tools. This section also asked respondents to rate their expertise in using computers and the Internet and in using media-rich real-time collaboration tools on a five-point scale from 'beginner' to 'expert'. The second section asked respondents which desktop video conferencing, room-based video conferencing, web conferencing and virtual world tools/platforms they had used and/or planned to use, as well as the circumstances under which they felt each type of technology was most appropriately used. In the third section of the survey, respondents were asked to provide detailed information about one subject or unit in which they had deployed media-rich real-time collaboration tools, with a focus on their use of the tools for synchronously uniting face-to-face and remote students, where applicable. The results from that section will be reported in separate publications.

Procedures

Respondents were recruited by advertising on national and international educational technology mailing lists (e.g. ascilite, HERDSA, ODLAA, DEANZ, ACODE, EDUCAUSE, ITForum) and through personal contact made by the members of the project team. A \$300AUD shopping voucher was offered as an incentive to complete the survey. The survey was delivered online from early December 2011 to late February 2012. Upon closure of the survey, all data were extracted as Excel files and quantitative data was analysed in SPSS.

Open-ended responses to the questions about appropriate uses of desktop video conferencing, web conferencing and virtual worlds were also analysed in order to provide a grounded indication of the circumstances under which the respondents believed each tool can and should be used. A cluster analysis was performed and among other things revealed that one group of respondents distinguished themselves by using a broad range of technologies. Responses from 100 people in this group were selected for detailed qualitative analysis, on the basis that they had the range of experience upon which to base selection and usage decisions. This qualitative analysis involved an open-coding phase to determine preliminary analytic categories, an axial-coding phase to determine emergent themes, and a selective-coding phase to support the conceptual coding categories (see Neuman, 2006, for further details on this approach).

Respondents

A total of 1,748 survey responses were received. After removing responses that were largely incomplete, not from an employee of an Australian or New Zealand university, or from someone who indicated that they were not using any media-rich real-time collaboration tools, 750 responses remained. Of these 750 responses that were used for the current analysis slightly more were from females than males (females: 54.2%; males: 45.8%). There was a wide range of ages in the sample (from under 26 years of age to over 65 years of age) and the mean age of respondents was approximately 48 years (based on the midpoints of the response ranges). The distribution of ages is reflective of that of the university sector, which tends to be positively skewed (i.e. comprising an older demographic). Responses were received from 38 of the 39 Australian universities and all 8 of the New Zealand universities.

Of the 750 respondents, the majority had been teaching in tertiary/higher education for 10 or more years (58%), and had 10 or more years' experience using computers and the Internet in their teaching (57%). On the other hand, only 14% of respondents had been using media-rich real-time collaboration tools for 10 or more years, and the majority (58%) had been using them for less than 5 years. A substantial number indicated that they had adopted these tools within the last year (24%) or in the past 1 to 2 years (14%). There were clear differences in the self-reported abilities of respondents when it came to using technology more generally for learning and teaching compared with using media-rich real-time collaboration tools. Over two-thirds of respondents (68%) indicated they had 'advanced' or 'expert' ability in using computers and/or the Internet for learning and teaching, while less than a third (31%) felt they had the same level of ability when it came to using media-rich

real-time collaboration tools for learning and teaching. Conversely, very few respondents reported being beginners or novices when it came to using computers and/or the Internet for learning and teaching (3.3%), while a significant minority (34%) felt they were at the beginner or novice level in the use of media-rich real-time collaboration tools for learning and teaching.

Results

General use of media-rich real-time collaboration tools

Respondents were asked to indicate which media-rich real-time collaboration tools they had used in the past or were currently using in their teaching. (They were given a list of 38 tools to choose from, and also allowed to specify additional tools that did not appear in the list.) These responses were classified into four more generic categories or types of tools: desktop video conferencing, room-based video conferencing, web conferencing and virtual worlds. Across the 750 respondents, there were 2,926 instances of media-rich synchronous collaboration tool use, representing an average of approximately four tools per respondent. As can be seen from Figure 1, desktop video conferencing (39.4%) and web conferencing (38.6%) were the two tool categories that were most used. There were fewer instances of room-based video conferencing (11.7%) and virtual world (7.4%) use.

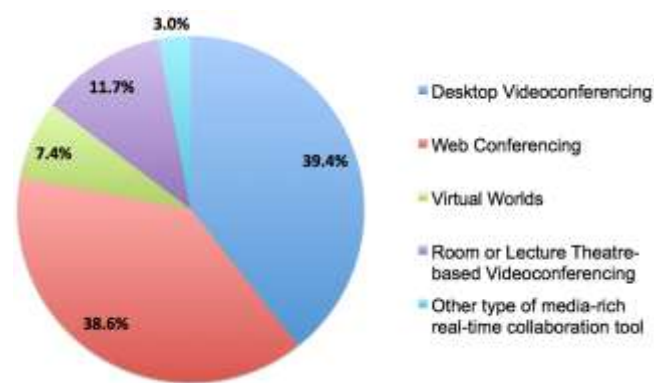


Figure 1: Percentage of uses of each type of media-rich real-time collaboration tool

In an attempt to track the use of media-rich real-time collaboration tools over time, respondents were asked to indicate the years in which they had used each of the four more generic categories of tool (see Figure 2). Figure 2 shows that the adoption of all media-rich real-time collaboration tools has increased significantly since 2000. But more interesting is the relative use of each type of tool. Room-based videoconferencing was clearly the dominant technology for media-rich real-time communication in 2000, and maintained this position at least until 2003. From 2004 to 2008 there was, broadly speaking, comparable use of room-based videoconferencing, web conferencing and desktop conferencing. From 2009 to 2010, web conferencing and desktop video conferencing tools were used by more respondents than room-based video conferencing, and the usage of these tools approximately doubled between 2008 and 2010. Moreover, while all four technologies have seen progressive growth in their user base, it is clear virtual worlds do not enjoy the penetration of the other three technologies, and even show a slight decrease in usage from 2010 to 2011. This may be in part be explained by the existence of a number of barriers to usage and institutional support issues associated with virtual worlds (see Dalgarno et al., 2011b) as compared to web conferencing in particular, which tends to be institutionally supported.

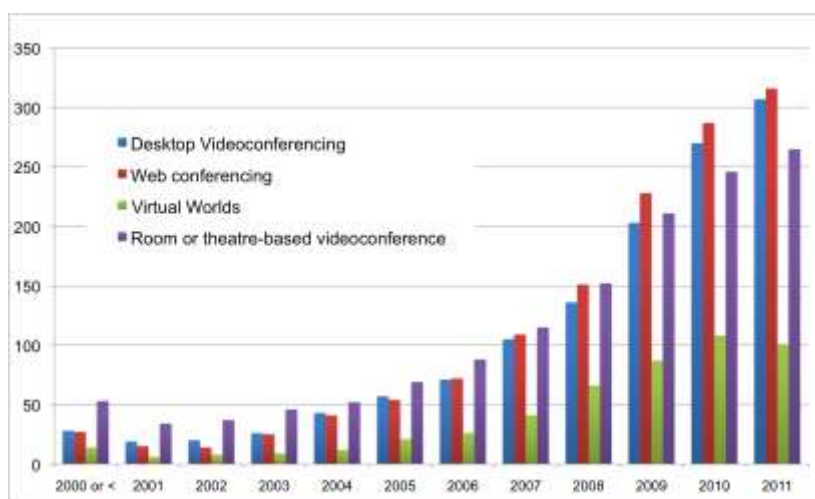


Figure 2: Use of media-rich real-time collaboration tools by year

Specific use of media-rich real-time collaboration tools

The next series of analyses examined the specific products that respondents were using with their students. Figure 3 shows the percentage of respondents in the sample that used specific web conferencing tools. It can be seen from Figure 3 that four tools in the web conferencing category are enjoying especially healthy patronage: *Elluminate* (30.9%), *Blackboard Collaborate* (30.6%), *Wimba* (20.8%) and *Adobe Connect* (20.5%). It is noteworthy that *Elluminate* was acquired by Blackboard, Inc. in 2010 and rebadged as *Blackboard Collaborate*. It is therefore likely that some respondents would have used *Elluminate* but not *Blackboard Collaborate*, some would have recently switched from *Elluminate* to *Blackboard Collaborate* within their institution, and others would have adopted *Blackboard Collaborate* without having previously used *Elluminate*. A consequence of this is that collectively, the proportion of people using either *Elluminate* or *Blackboard Collaborate* may well be substantially larger than 30%. Additionally, *Wimba* has been taken over by Blackboard, and although it continues to be supported as a separate product (see Wimba, Inc., 2010), it appears highly probable that there will be further consolidation of web conferencing platforms in the future.

Figure 4 displays the percentage of respondents using each of the tools in the desktop video conferencing category. Clearly *Skype* is the most popular tool, with 59.1% of respondents indicating they had used this tool in their teaching, which is double the number of users of the most popular web conferencing tool. *Windows Live Messenger* (16.0%), *Google Voice and Video Chat* (12.5%) and *Yahoo! Messenger* (9.8%) enjoyed moderate use. The proportion of respondents using each virtual world platform is depicted in Figure 5. It shows that use of virtual worlds is low compared to the other media-rich real-time collaboration tools. *Second Life* is the only tool with a significant user base, and even then it represents only 14.9% of the sample. It is noteworthy that with Linden Labs recent substantial increase in the cost of land in *Second Life* to educators, interest in *OpenSim* has grown, and a number of third-party grid providers have emerged (see Dalgarno et al., 2011a). Consequently, it could be assumed that the user base of *OpenSim* will continue to grow over the next few years.

Perceived ‘best’ use of media-rich real-time collaboration tools

Based on an initial analysis of the open-ended responses to questions asking respondents to list the best reasons for using each of the three main technologies (video conferencing, web conferencing and virtual worlds) for learning and teaching, some of the more common reasons for using the technologies are discussed in this section. Quotes from the actual responses are included to help illustrate the general categories of response identified. A more complete analysis of all responses will be reported in another publication.

Reasons for using desktop video conferencing often centred around location and group size. Desktop video conferencing was deemed useful when participants were “geographically dispersed” and the planned interaction was either “one-on-one” or for “small groups”. There was widespread agreement that desktop video conferencing was ideal when participants “do not require much more than audio and video capabilities to support teaching and learning”. Several respondents pointed out that desktop video conferencing was important when “visual interaction is required”, for instance if “the subtle nuances of facial expression is important”.

Some indicated that desktop video conferencing could be useful for developing a sense of “social presence and community”, particularly “with off-campus students to give them a more inclusive and intimate experience”.

Pedagogical situations considered by respondents to lend themselves to the use of desktop video conferencing included facilitating collaboration during project work, providing consultation hours, liaising with postgraduate and higher degree research students, and enabling online talks by guest speakers. The lightweight and easy-to-use nature of the software meant that some respondents felt desktop video conferencing was suitable for brief communication events and “informal” teaching situations, such as remedial instruction or question-and-answer sessions before exams, and checking in with students “in the field”. Some responses underscored the pedagogical impact of using desktop video conferencing, including that it could be used to increase the level of interaction, engagement and motivation. Desktop video conferencing was viewed as a tool for facilitating “learning conversations” and “dialogic pedagogies”. Several respondents alluded to the power of placing desktop video conferencing technology in the hands of the students to enable “student-to-student interactions”.

Web conferencing was seen to cater to a far greater variety of group sizes – anywhere from small groups, to tutorial-sized groups, to larger classes of “up to 100”. Several responses highlighted the flexibility of web conferencing; that it “can be used in almost any situation”. One respondent identified web conferencing as being suited to “1) small group situations when the purpose is to engage in learning conversations and question and answer discussions after a short presentation using relevant slides, 2) guest presentations and webinars when the

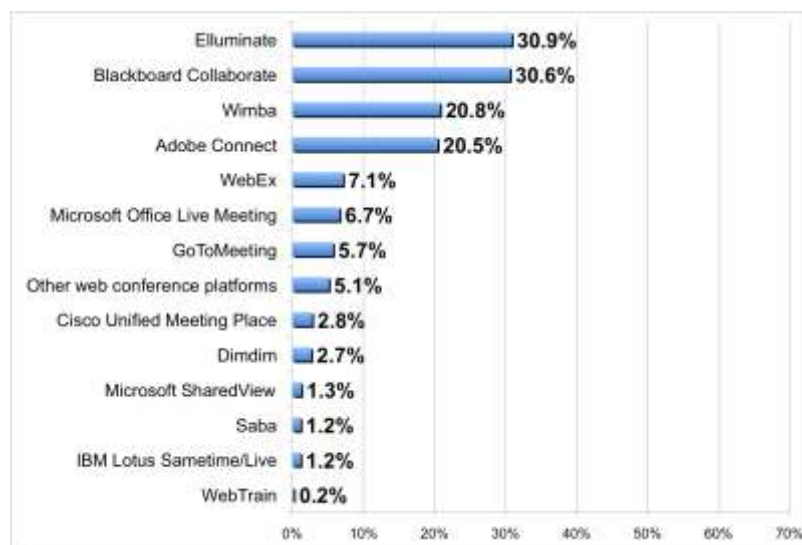


Figure 3: Percentage of respondents using a range of web conferencing tools

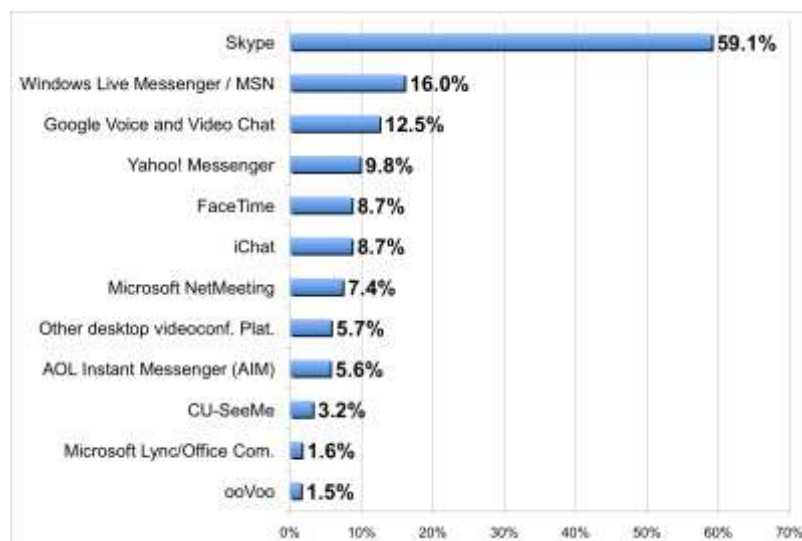


Figure 4: Percentage of respondents using a range of desktop video conferencing tools

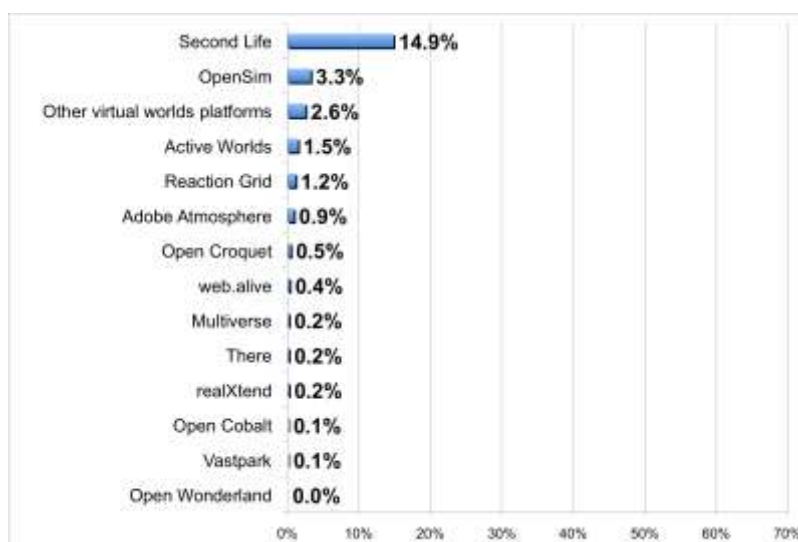


Figure 5: Percentage of respondents using a range of virtual world platforms

audience is geographically dispersed and they would be able to attend in person, 3) student presentations and small group work”. Other uses perceived as appropriate included lectures, student project collaboration, student presentations, providing online consultation hours, and briefs to large distance cohorts on assessment tasks. Some respondents expressed a view that web conferencing had the potential to transform pedagogy, for instance by using the separate audio and text channels to “allow more tutorial-style chat rather than a straight lecture”.

Several respondents related the selection of web conferencing to whether or not it afforded the required tools for the learning and teaching situation. For instance, one respondent indicated web conferencing was useful when “enhanced functionality such as screen sharing, voting, content sharing and collaboration are required”. Other suitable uses included “sharing files, PowerPoints etc plus real-time discussion... developing shared understandings through whiteboard activities”. Some respondents also identified the capacity to use “breakout rooms” as a distinct advantage for groupwork. Whereas desktop video conferencing was seen more as a tool that was used more incidentally, some people identified that for web conferencing sessions the presenter needed to be prepared. For instance, one respondent indicated that for large groups web conferencing “relies on well-organised and planned use by moderator”, but that even small groups also require “planning and practice if a formal session”. One respondent remarked that “the advantage of web-based conferencing programs is that the students can fully interact with the academic, other students *and the subject material*” (emphasis added). Like desktop video conferencing, web conferencing was also seen as a way to “enhance sense of belonging to group”, where the persistent nature of rooms could provide “sustainable connections for communities of practice”.

Virtual worlds were viewed by many of the respondents as a way to overcome limitations of the physical world, or in the words of one individual, “doing things that can’t be done in the physical space for technical/legal/safety/practical reasons, e.g. simulate dangerous equipment, processes etc”. Often, pragmatic reasons (such as financial considerations) were seen as a driver for choosing to use virtual worlds: “time, money and inability to do in real life are other excellent reasons to use a virtual world”, an example of this being “exploration of environments not otherwise available due to size or cost or distance – e.g. exploring nano spaces or designing sustainable buildings or visiting virtual museums”. In contrast to video conferencing and web conferencing, virtual worlds were seen as a way to provide a more “immersive” experience. One respondent saw as an advantage of virtual worlds the fact that students could choose to remain anonymous, and another felt virtual worlds could be used to nurture the social skills of some students who might lack confidence. Respondents rarely identified group size as a factor when deciding to use virtual worlds.

Some respondents felt that the range of uses of virtual worlds was almost limitless, with some of the many possibilities including “lectures, discussions, guest presenters, WebQuests, scenario-based training, simulations, role-plays, tours, excursions, bring[ing] people together from dispersed/remote locations, meeting experts from around the world, group work, collaboration, one-to-one [and] one-to-many synchronous work, asynchronous learning, only limited by your imagination”. Other suggested uses included virtual field trips, demonstrations, conferences, decision-making scenarios, as well as problem-based learning activities. Virtual worlds were seen as useful to facilitate game-based learning, and for assessment purposes. Some felt that virtual worlds tended to be more “discipline based”, for instance developing “clinical skills” in health-related disciplines, and in visio-

spatial disciplines such as creative arts and architecture. Virtual worlds were also seen as valuable for “language learning” and “cross-cultural collaboration”.

There was a range of comments relating to the technological requirements for and capabilities of each type of tool. The general consensus of these comments was that desktop video conferencing was easier to use than web conferencing, which in turn were seen as having a lower technical overhead than virtual worlds.

Discussion

Higher education institutions often make decisions about media-rich real-time collaboration technology deployment without any clear understanding of the tools that are available or how they are being used. Literature relating to these technologies is somewhat disjointed, meaning it is difficult to piece together a unified conception of the use of these technologies across the sector. This paper adds to the literature by providing an overview of how rich-media synchronous technologies are being used in Australian and New Zealand universities for learning and teaching purposes.

Based on the sample of 750 university teachers, desktop video conferencing and web conferencing are the most frequently used type of tool for learning and teaching purposes (approximately 39% each), with only 7.4% of tools identified falling into the virtual worlds category. The use of web conferencing and desktop video conferencing has more than doubled in the last four years; by contrast, the use of virtual worlds only increased by approximately 50% in the same time period, and actually declined from 2010 to 2011. The most frequently used rich-media collaboration product was the *Skype* desktop video conferencing tool, reported to have been used by 59% of respondents. The *Elluminate* and *Blackboard Collaborate* web conferencing systems were the most popular commercial tools, each enjoying 31% usage, followed by *Wimba* and *Adobe Connect*, each with 21% usage. The *Second Life* virtual world platform was the seventh most used of the tools (15% usage), slightly less popular than *Windows Live Messenger* (16%). The commercial and competitive nature of the web conferencing domain is likely to result in continued shifting of market dominance in the medium-term future, whereas desktop video conferencing and virtual worlds appear as though they will each be more or less monopolised by single products in a similar timeframe.

Responses from survey respondents with a broad range of experience teaching with media-rich real-time collaboration tools indicated that desktop video conferencing is generally most suitable for small-group and often informal sessions where audio and video are the modes of communication required. According to them, web conferencing adds the potential to cater to larger audience and enables more advanced modes of sharing (presentation slides, voting, drawing on a shared whiteboard, and use of breakout rooms for small-group discussion), but calls for greater levels of facilitator skill and preparation. Virtual worlds were essentially seen by these users as being useful as a simulation environment to overcome real-world logistics and to facilitate a more situated or contextualised and immersive learning experience.

Conclusion and future work

Eventually, improvements in telepresence technologies and associated hardware devices will mean that people from multiple locations around the world will be able to interact as though they are located in the same room. Until then, educators are tasked with the challenge of making the most of available media-rich synchronous technologies to facilitate real-time interaction between remote and on-campus learners and teachers. The findings from this study demonstrate that a range of web conferencing and desktop video conferencing tools are increasingly being used in Australian and New Zealand universities in order to achieve this interaction, with virtual worlds also being used in a smaller number of cases. It is intended that the findings from this study support higher educators and their institutions in making better-informed technology-selection decisions.

The authors plan to undertake further analysis of both the qualitative and quantitative survey data to yield deeper insight into the specific ways in which the tools are being used to simultaneously involve face-to-face and remote learners in real-time collaborative activities, as well as to identify determining factors for various clusters of users based on their tool use. The broader project of which this study forms a part is ongoing, with the project team working to develop a collection of learning design exemplars in the form of reusable templates encapsulating key pedagogical features and patterns, a technology capability framework to inform tool selection and use, and a set of practical guidelines to assist higher educators in designing media-rich real-time collaborative learning activities involving face-to-face and remote students. With reference to the survey data, six case-study implementations involving participating staff from several universities have been identified and are being followed and investigated through participatory evaluation. The project team is working closely with

the case-study partners to encourage renewal and enhancement of their existing practice, with the processes and outcomes to be documented and shared for the benefit of the higher education community.

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