A REVIEW OF E-LEARNING TECHNOLOGIES: OPPORTUNITIES FOR TEACHING AND LEARNING

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Abstract: The number of different e-learning technologies available to support teaching and learning is growing exponentially. A major issue for faculty and educational developers is to determine which e-learning technology is most appropriate to support their particular style of teaching and the optimum learning outcomes for students. The decision to use a particular technology should be based on sound research and clear evidence. Over the last few years a vast amount of literature has been published on e-learning technologies and how they are used in education. This paper reviews many of these e-learning technologies and provides information regarding their use and the opportunities afforded by them.

1 INTRODUCTION

The literature provides many definitions of e-learning since the term was first introduced in the late 1990s (Gerhard & Mayre 2002). Romiszowski (2004) counted more than 20 different definitions within 50 articles. In this study the comprehensive definition from Tavangarian, Leypold, Nölling, Röser and Voight’s (2004) review of the literature has been adopted: E-learning is “all forms of electronic supported learning and teaching, which are procedural in character and aim to effect the construction of knowledge with reference to individual experience, practice and knowledge of the learner. Information and communication systems, whether networked or not, serve as specific media …to implement the learning process” (p. 274). E-learning then is supported by technology.

Brewer, De Jonge and Stout (2001) suggest that: “Ideally, technology plays a transparent supporting role in the learning process … appropriate integration of learning technologies casts technology in the background … gratuitous and/or awkwardly or inappropriately employed learning technologies can actually juxtapose the role and importance of technology allowing it to compete with the learning process” (p. 39).

Educators need to be well informed and familiar with the available technologies if they are to use them effectively. Growing expectations that educators are not just familiar with but are also tech-savvy across a range of these technologies places increasing pressure on them (Orton-Johnson 2009; Thinyane 2010).

This paper is a literature review of technologies currently used in e-learning. It highlights the opportunities afforded by the use of the technologies to support different styles of teaching. The review is part of a larger project that aims to create and disseminate guidelines and exemplars of good practice in the selection and use of e-learning technologies.

Throughout this paper the term e-technology is used to describe a technology that supports e-learning.

2 THE PROJECT

Deakin University, a large university in Australia where this project is centred, has a focus on providing learning environments that “are flexible, student-centred and accessible to our diverse range of students, utilising appropriate technology to enhance teaching and learning and providing student support services which are responsive to student needs and responsive to students support needs” (derived from the University Teaching and Learning Plan). The University has sponsored many e-learning research activities in an effort to inform not only teaching practice, but also policy development.
One of the projects funded in 2010 was a study that aimed to provide an improved student experience of e-learning by developing resources for academics to enable them to make informed decisions as to the best use of e-technologies. This large project was achieved by identifying the experts (academic staff users) of the current online technologies within the University, and capturing their knowledge and expertise of using those technologies through interviews. These expert views were complemented by capturing student perceptions of using these technologies.

The number of different technologies available to academics to support teaching is growing rapidly as new technologies are tested in the classroom, and as innovative use is made of them. Technologies not originally considered as teaching tools (such as Facebook) are now permeating teaching and learning spaces. With this extensive portfolio of online technologies, it is difficult for the academic to determine which technology, if any, is most appropriate to support the pedagogical aims of their teaching.

There are a number of important outcomes planned for this project, the principal one being an easily accessible and usable set of guidelines with exemplars to inform staff and support them in their selection of the most appropriate technology for the student learning outcomes they are attempting to facilitate.

Grounded in the large body of literature, this paper provides a thorough review of the e-technologies used for teaching and learning at Deakin University in 2009, and these are classified using the categorisation proposed by Hamilton (2010). This review provides the building blocks for the empirical research, the results of which will be published in following papers.

3 METHODOLOGY

The overall project has five main phases:

1. A detailed literature review with a focus on articles published in 2009 or later. An annotated Endnote library was created during this process. The 40+ technologies identified from the literature were classified into 14 categories. This paper describes the classification framework and the relevant literature.

2. Review the staff experience of these technologies. Consultation with staff known to use e-technologies, combined with an investigation of the University’s website enabled the identification of teaching staff with expertise in teaching with particular e-technologies representative of the 14 categories identified. These e-technology experts, covering the University’s four faculties and four campus locations, were contacted by email and invited to participate in this research. Consenting staff were interviewed regarding their use of, and the perceived benefits of, the e-technologies. The interviews therefore focused on staff rationale for adopting the technology (the affordances it offered); with reference to Chickering and Gamson’s (1987) ‘Seven Principles of Good Practice’ an indication of which of the principles the e-technology supported and how; challenges, difficulties or failures staff encountered during or post implementation of the e-technology.

3. Identifying student perceptions of these e-technologies; their learning through and with them; and any perceived benefits and shortcomings. Students who were enrolled in classes in which the e-technologies adopted by the staff were invited by email to participate in focus groups.

4. Thematic analysis of the collected qualitative data supported by Nvivo software, using first-cycle and second-cycle coding strategies outlined by (Saldaña 2009).

5. Reporting the findings of the study and producing guidelines

The outcome of Phase 1 provides a strong basis for the empirical part of this project. The results of this phase are presented in this paper.

3.1 Literature Review

A review of the e-technologies used for teaching and learning at Deakin University in 2009 revealed that the University supported 23 components which are core within, or power-linked from the online learning environment, as well as nine other e-technologies. The authors were also aware of at least seven e-technologies that were being used on an ad-hoc basis by staff to support teaching and learning. This list of e-technologies (39) together with a categorisation by Hamilton (2010), were used as the starting point to compile categories of relevant literature (see Table 1).

For this review, the broader categories of virtual learning environments (VLE), online learning environments (OLE), and learning management systems (LMS) have been excluded. The exclusions include products such as Blackboard, SAKAI,
Moodle, Desire2Learn, AJAX and others that identify as OLE, VLE or LMS. The rational here is that generally these very large systems are centrally supported within the university environment and have adequate resources, support and exemplars to allow informed decisions to be made about their use to support specific pedagogical requirements, unlike the range of e-technologies being investigated here. Further, the use of such systems is usually prescribed by the institution and teachers to not have the opportunity of opting out of using it.

A search of selected 2009+ journals (Table 2) was undertaken to explore the most recent uses of the e-technologies in educational settings. These peer-reviewed journals were chosen from the Australian Field of Research classifications of 1301 (Educational Systems) and 1303 (Specialist Studies in Education).

Table 1: Categories of e-technologies

<table>
<thead>
<tr>
<th>Category</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment and Survey tools</td>
<td>Respondus, Quiz Builder, StudyMate, Zoomerang, Survey Monkey, ExamBuilder</td>
</tr>
<tr>
<td>Asynchronous Communication</td>
<td>Email, Announcements, Discussion forum, SMS</td>
</tr>
<tr>
<td>Digital Repositories</td>
<td>Google Scholar, ePortfolio, Equella, Youtube</td>
</tr>
<tr>
<td>Management and Administration tools</td>
<td>Turnitin, Gradebook, iGoogle, myYahoo</td>
</tr>
<tr>
<td>Photosharing</td>
<td>Flickr, Gallery2, Zoomr, Picasa, Photobucket</td>
</tr>
<tr>
<td>Podcasts, Vodcasts and Streaming</td>
<td>Podcast, iLecture, iTunesU, MyPod, ePodcast</td>
</tr>
<tr>
<td>Shared Documents</td>
<td>Google Docs, Zoho Writer, SlideShare, Elgg, Clearspace</td>
</tr>
<tr>
<td>Social Bookmarking</td>
<td>del.icio.us, CiteULike, Simple, Diigo, Connotea, digg, reddit</td>
</tr>
<tr>
<td>Social Networking</td>
<td>Facebook, MySpace, Bebo, Ning, LinkedIn</td>
</tr>
<tr>
<td>Subscribed Content Delivery</td>
<td>Google Reader, Bloglines, RSS Feeds</td>
</tr>
<tr>
<td>Synchronous Communications</td>
<td>Google Talk, iChat, CUworld, ICQ, Skype, Elluminate Live, MSN /Yahoo messenger</td>
</tr>
<tr>
<td>Virtual Worlds</td>
<td>Second Life (SL), Virtual Graffiti, eSimulations</td>
</tr>
<tr>
<td>Weblogs and Microblogs</td>
<td>Blogger, Wordpress, Twitter, RAMBLE, Yammer</td>
</tr>
<tr>
<td>Wiki</td>
<td>PBWorks, Wikispaces, MediaWiki, WikitPad, Zwiki</td>
</tr>
</tbody>
</table>

Table 2: Initial sources

<table>
<thead>
<tr>
<th>Selected journals</th>
<th>ERA ID</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALT-J Research in Learning Technology</td>
<td>20266</td>
<td>A</td>
</tr>
<tr>
<td>Australasian Journal of Educational Technology</td>
<td>20265</td>
<td>B</td>
</tr>
<tr>
<td>British Journal of Educational Technology</td>
<td>20263</td>
<td>A</td>
</tr>
<tr>
<td>Computers and Education</td>
<td>17811</td>
<td>A</td>
</tr>
<tr>
<td>Educational Technology Research and Development</td>
<td>10328</td>
<td>A</td>
</tr>
<tr>
<td>Higher Education Research and Development</td>
<td>20348</td>
<td>A</td>
</tr>
<tr>
<td>Interactive Learning Environments</td>
<td>20276</td>
<td>B</td>
</tr>
<tr>
<td>Journal of Higher Education</td>
<td>19312</td>
<td>A</td>
</tr>
<tr>
<td>Research in Higher Education</td>
<td>20352</td>
<td>A</td>
</tr>
<tr>
<td>Teaching in Higher Education</td>
<td>19316</td>
<td>A</td>
</tr>
</tbody>
</table>

4. REVIEW OF E-TECHNOLOGIES

The following section provides a critical review of the affordances of e-technologies identified in the previous section, including a brief introduction to their use for educational purposes.

4.1 Assessment and Survey Tools

Tools for formative and summative assessment being used in tertiary education include: quiz and survey tools, eExaminations and those for visualisation and activity development. Such tools are found to encourage student learning and enable a better understanding of student behaviour in teaching environments.

Online surveys or quizzes are generated for testing purposes or used as a learning tool incorporating automatic feedback. Surveys can be created through an LMS, or using web-based survey tools such as SurveyMonkey or Zoomerang. In a study of mathematics students using a Respondus quiz, Angus and Watson (2009) found that higher exposure to such online instruments lead to higher student learning all else being equal. The use of the web-based MathXL with features such as self-paced homework and a test manager allowed automatic grading and targeted feedback (Buzzetto-More & Ukoha 2009).
The use of online examinations (eExaminations) is becoming more prevalent and there are efforts to move away from multiple choice questions to more sophisticated software tools. Fluck, Pullen and Harper (2009) describe a system using an open source CD on student owned laptop computers that was supervised by invigilators without specialist information technology skills.

There are also a variety of visualisation tools that help teachers to better understand students’ cognitive levels and how they might progress through concepts and learning materials. These tools vary from CourseVis, that graphically renders student tracking data collected by a CMS (Mazza & Dimitrova 2004), to a tool described by Costagliola, Fuccella, Giordana and Polese (2009) that allows tutors to monitor a learner’s strategies during online tests by using data visualisation. Although the focus with these tools is not on student assessment per se, they nevertheless provide a means of understanding behavioural patterns of students better, thus allowing for improved assessment processes. In a classroom tools such as Votapeadia can enable questions to be answered by large groups of students using their mobile phones. Similarly an Audience Response System (aka clickers) help motivate and engage students while simultaneously providing feedback on their understanding of material (Johnson & Lilis 2010).

4.2 Asynchronous Communication

In educational settings Email is a commonly used asynchronous communication tool for one-to-one or one-to-many online communication. It can transmit files that include text, graphics and other multimedia content with or in the messages. The strengths of email include the immediacy of the technology, the ability to connect and be connected, ease of use and flexibility (Dawley 2007). However these may be seen as weaknesses as they create expectations upon the educator to be always connected and contactable. Other weaknesses include the potential for misunderstandings through lack of non-verbal triggers such as tone or mood, as well as the need to establish and enforce boundaries and netiquette (Koehler & Mishra 2009). Such weaknesses are accentuated when corresponding with distance students or students with English as a Second Language (ESL).

Another type of asynchronous communication tool used in tertiary education is the discussion forum, which allows participants to post to a bulletin board or forum which can be viewed and responded to by others at any time. However a major disadvantage of discussion forums is the length of time it takes to hold a conversation. Pena-Shaff, Altman and Stephenson (2005) suggest that the use of online discussion forums has the potential to increase students’ participation and interaction when used as a supplement to face-to-face learning activities. Discussions also support online communication and collaboration in situations where face-to-face communication is not possible (Goold & Coldwell 2005). Klisc, McGill & Hobbs (2009) suggest that when assessment is associated with discussion, there are higher levels of participation and quality of outcomes than when no assessment is used.

Announcements are a further type of asynchronous communication tool useful and widely used in educational settings. An announcement is a broadcast message to a predefined group of people such as a class of learners. It is a useful way of notifying the group(s) of breaking news, last-minute events or simply reminders of key dates. Announcement tools are often incorporated into learning management systems.

Short message service (SMS) is a method for sending messages to mobile phones and these are becoming more commonly embedded in tertiary pedagogy. Additionally, an SMS message can be sent from a mobile phone or from a computer connected to the Internet. Anderson and Blackwood (2004) report that the widespread adoption of mobile devices together with the increased emphasis on lifelong learning have become key drivers in the development of applications and uses of mobile devices. A number of experimental projects have shown promise in this area such as the mobile learning tool developed by Cavus and Ibrahim (2009) which encouraged language students to learn new words via their mobile phones.

4.3 Digital Repositories

This category covers a plethora of different content management systems and the search engines that index them. Digital repositories typical in tertiary education incorporate online bibliographic databases that provide abstracts and indexing to the world’s scientific and technical papers in wide-ranging disciplines. Bibliographic databases, of which there are more than 100, include PubMed, IEEE Xplore, Scopus, Web of Knowledge, Web of Science and Google Scholar and are easily accessible through institutional libraries.
Another type of digital repository is the learning repository created from combinations of in-house and third-party resources, enabling academics to retrieve and share these resources (Atkinson, Fluker, Ngo, Dracup & McCormick 2009). An issue with these types of sites is their sustainability with the advent of Web 2.0 tools where sites are “self-sustaining because users see a value in continuing to add content and share resources” (Conole and Culver 2009, 763).

The eportfolio is a type of digital repository where the focus is on an individual’s collection of artefacts. They facilitate “the process of collecting, reflecting on, sharing, and presenting learning outcomes and other professional accomplishments via a digital medium” (Fitch, Reed, Peet & Tolman 2008, p. 38). Eportfolios have been used in educational contexts such as:

- English language teaching for students to record and demonstrate evidence of learning and development (Cheng & Chau 2009);
- As a medium for creating awareness of the importance of lifelong learning for students (Heinrich, Bhattacharya & Rayudu 2007);
- Professionals who are required to provide evidence of competence and professional development (Kardos, Cook, Butson & Kardos 2009);
- Supporting and empowering women returning to employment (Herman & Kirckup 2008);
- As a management system to store lesson plans of student teachers and allow subsequent evaluation and detailed analysis (Swan 2009).

The use of eportfolios can help students better understand learning goals and reflect on the knowledge and skills they have developed (Buzzetto-More 2010; Lopez-Fernandez & Rodriguez-Illera 2009). Structure and organisation of eportfolios should reflect the “messages” that the tool is bringing (Brandes & Boskie 2008).

Innovative use of eportfolios is being made in areas that link education to the domain of professional development planning, supporting reflection on professional goals and career planning (Bratenegyver 2008) and in work-integrated learning (Koch 2010). In these contexts, Dorninger and Schrack (2008) emphasise the importance of having a common framework of content demands and technical environments.

4.4 Management & Administration Tools

Tools that are used for teaching and the management of students and their learning include those tools used for administration of students’ grades and reporting of student progress, and tools for the detection of plagiarism. Also included here are tools to support the building of groups and provision of infrastructure to support group work such as private discussion spaces and shared document spaces.

An electronic gradebook is a student information system which stores students’ demographic data and allows grades and other data to be recorded. The data can be edited, released for viewing and exported. “Students really appreciate the ability to see their overall progress in a course at any given time” (Dawley 2007, 185). Tracking and reporting tools provide the means to monitor students’ access to online components of a course or of completion of tasks.

Online plagiarism detection software is used in a variety of ways. It is often a way of encouraging students to reference correctly and to write assignments in their own words (Sheridan, Alany & Brake 2005). For teachers it is a detection tool to ensure that work submitted by students is their own. Online plagiarism software can also be used purely as an assignment submission tool (Dahl 2007). While Turnitin is the most widely used plagiarism detection software available in high schools and universities, other tools with specialised features have been developed for internal use (see for example Butakov and Scherbinin (2009)). Chao, Wilhelm and Neureuther (2009) showed that students who had been given instruction and exercises in paraphrasing and citing to avoid plagiarism, were less likely to plagiarise.

Personalised homepages allow users to pull information such as news, weather, gadgets, webpage links and RSS feeds from multiple sources into one fully customizable page. Netvibes, Pageflakes, My Yahoo, iGoogle and Windows Live all allow the creation of personalised homepages. There appears to be very little literature on the use of homepages for educational purposes but Marathe (2010) has begun to explore the creativity enhancing potential of such environments with students.

4.5 Photo sharing

The use of photosharing websites has the potential to “open lines of dialogue, communication, and learning” (Fisher & Baird 2006 - 2007, p. 22). Flickr is an example of a website which enables the publishing of photos online so that they can be shared with others either publicly or privately. Users can make annotations, leave comments and have ongoing discussions about the images. The
discussion generated by the group remains visible in Flickr for future reference.

Buffington (2008) explains that such sites can be used to compare and contrast images in fashion or art courses. Students on a field trip, who take photos with their mobile phones, can instantly post them online. Later the students can reflect and discuss, through the photosharing tool, their experiences and observation with the rest of their learning community (Fisher & Baird 2006 - 2007). Godwin (2007) describes how a group of nearly 2000 librarians has formed on Flickr. They have accumulated over 13,000 pictures and images accessible to all members. Another example of an educational use is the group of photography students who have collaborated across universities to create and comment on virtual photo albums using Gallery2 (Samarawickrema 2007).

4.6 Podcasts, Vodcasts and Streaming

The term podcast is a contraction of iPod and broadcast. A podcast is an audio or video file that can be downloaded from the Internet to a computer or mobile device that is capable of playing MP3 or MP4 files. Most podcasts have RSS capability (see subscription content) allowing users to automate the process of accessing recent additions. A video podcast (vodcast) refers to online delivery of video content (educational resources in this case) on demand. Streaming audio or video on the other hand is data sent in a compressed format that is played in real time at the destination. Unlike podcasts and vodcasts, playing a streamed file can lead to stop-start reception depending on the speed at which the data is transmitted. Such media is becoming commonplace in education, particularly in distance learning with many of the world’s prestigious universities now distributing their lectures through services such as iTunes (e.g Stanford and Harvard).

Considerable research has been undertaken into the use of both teacher-generated and student-generated podcasts in learning environments. Hew (2009) reports that the most common use of podcasts is for delivery of lectures and supplementary recordings. With the advent of iTunes U, podcasting was touted as the answer to learning anytime, anywhere and high profile universities made podcasts of lecture series freely available (McKinney, Dyck & Luber 2009). Other projects have demonstrated the versatility and efficacy of podcasts as a means of engaging students in their learning (Buffington 2008; Lazzari 2009; Middleton 2009). Barriers to sustainable use of podcasts in education include unfamiliarity with the technology, lack of perceived relevance to teaching or learning and lack of time to prepare podcasts (Hew 2009). Middleton (2009) highlights lack of technical support and technical confidence as barriers to institutional scalability of podcasting. However Sutton-Brady, Scott, Taylor, Carabetta & Clark (2009, p. 219) suggest that “the majority of students believe they gained learning benefits from podcasts and appreciated the flexibility of the medium”.

4.7 Shared Documents

Numerous collaboration applications exist which enable the storing, editing and reviewing of documents in a virtual space. This can be done by multiple individuals, either in real time or asynchronously. By using a web browser and an application such as Google Docs students can access a group’s documents, edit and save them (Southavily, Yacef & Calvo 2009). Shared document technologies such as Google Docs are considered particularly useful if or when the university adopts Gmail (Google mail) as their email system, which has been the case in many Australian universities. Such technologies are then extremely convenient particularly for students.

These collaboration technologies enable students and faculty to see what changes have been made to the documents and by whom. This facility is not confined to text documents but a group can be working collaboratively on spreadsheets and presentations (EDUCAUSE 2008) which is considered useful in group work situations.

4.8 Social Bookmarking

Social bookmarking is the practice of saving a link to a web site as a public or private bookmark then tagging it with meaningful keywords (Lomas 2005). These bookmarks are then available, in an organised manner, from any internet connected device (Buffington 2008). It is possible to see how many other users have bookmarked a site, what else these users have bookmarked, and to search for resources by tags, person or popularity. Heymann, Koutrika and Garcia-Molina (2008) suggest that this user generated content is a new source of information as it describes the web pages directly.

Commonly used social bookmarking sites include del.icio.us, Simple and Diigo as well as Connotea and CiteULike which are aimed predominately at scientists (Godwin 2007). However there are over 250 other sites that offer this type of
service. In 2008 about 115 million bookmarks existed in del.icio.us alone (Heymann et al. 2008).

In an educational setting Lomas (2005) suggests that social bookmarking simplifies the distribution of resources such as reference lists, bibliographies and articles to students and colleagues. Buffington (2008) organises her students to use social bookmarking to build a repository of information. Shared bookmarks can lead to the discovery of further resources while the creation of tags also encourages critical thinking (Godwin 2007), which suggests they are particularly useful in educational contexts. Lomas (2005) however has two concerns with social bookmarking which could occur when using them in teaching: users may assign inconsistent, inadequate or even negative tags to resources; and the storage of data in yet another location outside of the university learning management system that has to be maintained and updated, which adds another level of complexity.

4.9 Social Networking

Social networking creates online communities where people share interests and activities. Users are able to choose how they are “seen” within this community by creating profiles for themselves and can choose what information they wish to share.

While social networking sites like Facebook, MySpace and Bebo were not developed as educational tools they have been eagerly adopted by some educational institutions seeking new levels of student engagement and interactivity (Boon & Sinclair 2009). Eberhardt (2007) notes that Facebook is a feature of contemporary student life and transition to university can be eased through interactions with numerous online communities. Some educational institutions are concerned by the possibility of postings which might be considered inappropriate and they addressed this by blocking access to Facebook through their network (Bugeja 2006). Contrary to the negative perceptions of using this very popular technology in an educational context, De Villiers (2010) found that the use of Facebook for academic discussions with post graduate distance learning students enhanced student’s learning and insight.

Cloudworks is one social networking site specifically developed for educational purposes. Conole and Culver (2009, p. 779) state that Cloudworks harnesses Web 2.0 principles of connecting and sharing by bringing together “teachers/designers to share, discuss and find new ideas and designs”. LibraryThing, another social networking site developed with an educational flavour, enables users to share information about books that they have read. Godwin (2007) suggests this social network can be used to encourage students to read or to undertake critical reviews. Using technological infrastructures such as Joomla and Drupal, social networking sites have also been created specifically for individual courses or sub groups within institutions. Each of these social networking sites have a slightly different focus on different areas of social interaction (Weaver & Morrison 2008) making their fit for purpose a necessary consideration when using them in teaching.

Boon and Sinclair (2009) caution that online social networking does not come without concerns: the uncertainty of someone’s online “identity” can lead to lower levels of engagement; there can be an emphasis on superficial issues; and problems may arise with authenticity and trust. Students also need to be made aware of the visibility of their online behavior and recognize the long-term consequences of sharing personal information and how it may (negatively) impact future relationships, careers or employment (Fisher & Baird 2006 - 2007; Kolek & Saunders 2008). This issue is especially pertinent when using social networks for the delivery or support of education, where individual profiles and individual communications may be accessed by faculty delivering the teaching materials. Furthermore Foulger, Ewbank, Kay, Popp and Carter (2009) argue that for educators, the technology presents a new medium where the scope of their authority and responsibility is not always clear.

4.10 Subscribed Content Delivery (RSS Feeds / aggregators)

RSS, short for Really Simple Syndication or Rich Site Summary, provides a means of keeping up-to-date with content on the Internet that is updated frequently. It allows content distributors to syndicate content and post it as an RSS file on the Web (Glotzbach, Mohler & Radwan 2009) which a news reader can then easily download and check for updates. Individuals who subscribe to an RSS feed are notified when new items are added. The newsreader is accessible via the Internet, desktop computer, or mobile phone. The feed is in a standardized format, which allows it to be published once and viewed by many different programs. The reader provides a user interface to monitor and read the feeds as well as functions that enable users to
search, organise, manage and share their RSS posts. Often email programs and web browsers have the ability to display feeds. Such technologies pose new possibilities for e-learning and the distribution of teaching materials.

There are any number of general readers easily appropriated for education such as Google Reader and Bloglines, and there are also specialised aggregators freely available including MedReader targeting medical and healthcare professionals. Recent classroom experiments have found mixed results with student uptake of this technology (Glotzbach et al. 2009; Lee, Miller & Newnham 2009).

4.11 Synchronous Communication

Synchronous communication has many forms and is the closest technology-supported communication mode to face-to-face communication. It has an immediacy that asynchronous communication lacks. Synchronous communication can be text or audio based and can include video, multimedia, document and desktop sharing. Synchronous communication is facilitated through chat rooms, instant messaging and video-conferencing and is often used in education.

The need to support distance education and remote learners has prompted the use of synchronous tools to facilitate communication in environments where face-to-face is not possible. It has been used in a variety of learning environments, including small group teleconferences (Bliedener 2006); professional development for teachers (Chen, Chen & Tsai 2009); virtual assistants as online facilitators (Blignaut & Nagel 2009); and supporting acquisition of study and literacy skills (De Fazio, Gilding & Zorzenon 2000).

Although some researchers have found that there are differences in the use of synchronous tools which are dependent on factors such as culture (Wang & Reeves 2007) others have found that using such tools may cut through potential barriers. A study undertaken by Rutter (2009) suggests that the use of synchronous communication tools brings benefits to student support through efficient communication. Such tools can also be used to promote cooperation among students who work individually on their computers at home (Bliesener 2006) and to cut national and cultural boundaries (Harrison, Aschermann & Buckley 2003). Pelowski, Frissell, Cabral and Yu (2005) found that the immediacy of synchronous tools to facilitate class communications afforded a number of benefits to students that asynchronous communication tools did not achieve.

4.12 Virtual Worlds

A virtual world is a simulated environment through which users can interact individually or with others to use and create objects. Virtual worlds include multi-user virtual environments (MUVEs), and eSimulations, which are ideal for classroom teaching situations.

MUVEs are “environments that support learning activities such as experimentation, exploration, tasks selection, creation, and dynamic feedback” and “provides opportunities for social interaction, collaboration, an increased sense of shared presence, partially dissolved social boundaries, and lowered social anxiety” (Jarmon, Traphagan, Mayrath & Trivedi 2009, p. 170). With a MUVE there is no predetermined narrative. MUVE designers have the freedom to define and create the environment most suitable for their teaching context (Warburton 2009) and use it as an alternative model of education (Twinning 2009). Second Life (SL) is by far the most popular MUVE and applications can be found in many disciplines and educational contexts (Twinning 2009; Warburton 2009; Wheeler 2009). In SL, the user is represented by an avatar, a graphical image that represents a person, and can interact with other avatars in a 3-D virtual environment. SL offers an alternative space where learners can gain experiences that may not be possible in the real world. These include hypothetical or imaginary experiences or those involving large risk (Boon & Sinclair 2009; Jarmon et al. 2009); or where these experiences would be too expensive to produce in real life (Wheeler 2009). Twinning (2009, p. 498) suggests that they are also “spaces which encourage playfulness and testing of boundaries”.

There are some concerns about the MUVE as learning environments however. “The omnipresent artificiality of identity within these spaces and the concomitant challenges to frameworks of trust and truth may leave some students feelings distracted, isolated, or even disconnected” (Boon & Sinclair 2009, p. 108). This finding is supported in the literature (Omale, Hung, Luetkehans & Cooke-Plagwitz 2009; Warburton 2009). Another concern is that educators are ill prepared to take advantage of these new technologies (Twinning 2009), which could seriously complicate student/teacher interactions.

ESimulations are computer-based simulations that are delivered via a computer network and increasingly from mobile screens. The major
benefits of simulations are that they are interactive, stimulating and enjoyable for learners and they provide single-user or team interaction in realistic or real-world scenarios where trial-and-error learning in a risk-free setting is possible (Cybulski 2007).

Many other attempts have been made to provide simulated learning experiences to students including:

- The use of live broadcasts using a small-scale, satellite-based expedition transmission package into remote areas which brought a “live experience” back to students on campus (Robert & Lenz 2009).
- The creation of a virtual learning environment on CD that emulated a fire investigation activities scenario (Davies & Dalgarno 2009).
- The utilization of a fictitious telecommunications organisation (website) as a context for engaging students in professional practice (Goold, Augar & Farmer 2006).

4.13 Weblogs and Microblogs

A blog (weblog) is a web page where the owner writes personal commentary, or opinions, to which readers have the ability to leave comments (Duffy 2008). The owner of the blog directs its content with dated postings of items in reverse chronological order containing text and images. The blog may incorporate a number of features such as links, taglines, permanent links, blogrolls and archives (Farmer & Bartlett-Bragg 2005). A blog owner requires motivation to post regularly placing increased pressure on educators using the technology; however various applications such as RAMBLE and Google’s Blogger Mobile enable bloggers to easily send messages and images directly to their blog from their mobile phones (Fisher & Baird 2006 - 2007).

Blogs can provide a sharable student writing space, a mechanism to record a student’s progress or be used as a digital display of a student’s work and achievements (Duffy 2008). Blogs have the potential to improve the correctness, completeness and innovations of achievements by students (Chu, Hwang, Tsai & Chen 2009). Hou, Chang, and Sung (2009) suggest that blogs can also be a way for teachers to share information and experience, though in their study the use of the blog for knowledge construction was limited. Buffington’s (2008) experience with implementing blogs in a university however were mixed.

Blogging “small nuggets of knowledge”, typically in postings of 140 characters or less, which can be read on the web or on mobile devices (Skiba 2008) is known as microblogging. Examples include Twitter (where each posting is known as a tweet) Jaiku, Tumblr and Pownce. Yammer is a “private” microblogging tool. It restricts user access to a community by an email domain name. Instructional uses include as a tool for effective professional development and collaboration (Grosseck & Holotescu 2008); making announcements as well as collaborative story writing (Skiba 2008); and enhancing the social, cognitive and teacher presence in an online course (Dunn & Lowenthal 2009). Roth and McCully (2010) argue that while these type of social media tools may facilitate student collaboration they need to be simple and purposeful.

4.14 Wikis

Wikis are a collection of web pages designed to allow multiple authors to create, edit and delete content at any time and from anywhere (Cunningham 2005) and they are particularly suitable for group work in education. Content is built collaboratively with many users being able to structure the content, create links and track a history of contributions (O’Leary 2008). The pages within the wiki can be interconnected and organised as necessary as there is no predetermined structure (Duffy 2008). The most well known wiki is the online encyclopedia Wikipedia (2010). Currently Wikipedia has over 14 million articles from 85,000 active contributors in more than 260 languages.

Application of wikis in the academic context include fostering learning in students (Ruth & Houghton 2009); the collaborative writing of a textbook by faculty and students (Ravid, Kalman & Rafaeli 2008); as a tool to understand artworks (Baffington 2008); and to improve report writing amongst students (Neumann & Hood 2009). Hernandez-Ramos (2004) suggests that wikis promote the art of reflective writing due to the public nature of these tools. However some students experience feelings of uncertainty if they are not accustomed to writing and publishing their ideas to such a wide audience (Hernandez-Ramos 2004). Neumann and Hood (2009) suggest that using a wiki can improve student engagement with content but they found no evidence that students’ performance was also enhanced. However Cole (2009) did not find an increase in student engagement amongst her students though this may have been due to an unattractive course design.

The accuracy, relevance and verifiability of the content of wikis can be questionable (Dawley 2007; Giles 2005). However O’Leary (2008) argues that
they can be as accurate as traditional published sources but acknowledges that a lack of peer reviewing does result in a lack of quality assurance and that authors can introduce bias.

5. DISCUSSION: AFFORDANCES OF E-TECHNOLOGIES

The rate at which new e-technologies are emerging is rapid and hence any list which attempts to capture them will soon be out of date. For example since undertaking this review the researchers have encountered the Bliki, a combination of a blog and a wiki (Huang & Yang 2009), and the SNAG, a suite of mobile phone and internet games to facilitate networking between group members. Other tools such as Google Wave, a combination of synchronous and asynchronous communication, showed much promise (Feldstein 2009). In 2010 active development of Google Wave was discontinued and a full shut down of the product occurred in April 2012. However, the list of categories of e-technologies is less likely to change but rather specific entries will be extended by new innovations.

The technologies which are most likely to impact teaching and learning in higher education in the future are listed in the latest Horizon Report (Johnson, Levine, Smith & Stone 2010). The report suggests that cloud computing and collaborative environments will have a significant impact on teaching and learning over the next 12 months, however with recent reports of ‘clouds’ being hacked, such as Sony’s Playstation network in April 2012, such technologies are not immune from misuse and negative consequences. The report suggests that in the medium term (two to three years), game-based learning and mobile devices will be key drivers in pedagogical developments. In four to five years, the report suggests that augmented reality and flexible computer displays will be used, even though in reality these may only be adopted within this time frame by a few in the mainstream, those with substantial funds and infrastructure to support them.

To put this discussion in context, it is important to consider the key trends that are driving the adoption of technology in the classroom (Johnson et al. 2010):

- Technology as a means for empowering students, a communication and socializing tool that is ubiquitous and transparent.
- Technology is continuing to impact workplaces and elsewhere.
- The value placed on innovation and creativity is increasing.
- There is a move to just-in-time, less formal, modes of learning.
- Perceptions of the learning environment are changing.

The review of e-technologies presented in this paper is aimed at helping to understand which e-technology is appropriate for which style of teaching and learning.

6. CONCLUSION

The popularity of emerging digital technology presents new opportunities and challenges for educators. Farnan, Paro, Higa, Edelson and Arora (2008) argue that educators need to familiarize themselves with the advances in digital media, not only to take advantage of the educational opportunities they provide, but also to encourage safe practices and professional behavior by students using these technologies. Armatas, Holt and Rice (2005) warn however that a constant challenge will be “to integrate the possibilities of the emergent [technology] with ongoing commitments to the established corporate technologies”.

As part of ongoing research, a future project will seek to expand the number of e-technologies reviewed and provide dissemination of best practice and exemplars via the web as well as providing the mechanism for ongoing updates.

REFERENCES


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