

# 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 in higher education is to determine which e-learning technology is most appropriate to support their particular teaching needs and provide optimum learning opportunities for students. Over the last few years a vast amount of literature has been published on e-learning technologies and how they are used in education. Therefore the decision to use a particular technology should be based on sound research and clear evidence. 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 and Mayre 2002). Romiszowski (2004) counted more than 20 different definitions within 50 articles. In this study the comprehensive definition from Tavangarian, Leypold, Nölting, 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 for e-learning. However the number of different technologies available to educators continues to grow rapidly and technologies not originally considered as teaching tools (such as Facebook) are now permeating teaching and learning spaces. There are also growing expectations that educators are tech-savvy and familiar with a wide range of technologies. These expectations have placed increasing pressure on educators (Orton-Johnson 2009; Thinyane 2010).

This paper is a review of recent literature of current technologies used in e-learning in higher education. It describes some of the uses of these technologies for teaching and learning and highlights the opportunities afforded by their use.

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

## 2 BACKGROUND

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.

An initial step was to review the e-technologies used for teaching and learning at Deakin University at that time. This revealed that the University supported 23 components which were 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 technologies (see Table 1).

Table 1: Categories of e-technologies.

	e-technology Tool	Examples
1	Assessment and Survey tools	Respondus, Quiz Builder, StudyMate, Zoomerang, Survey Monkey, ExamBuilder
2	Asynchronous Communication	Email, Announcements, Discussion forum, SMS
3	Digital Repositories	Google Scholar, ePortfolio, Equella, Youtube
4	Management and Administration tools	Turnitin, Gradebook, iGoogle, myYahoo
5	Photosharing	Flickr, Gallery2, Zoomr, Picasa, Photobucket
6	Podcasts and Streaming	Podcast, iLecture, iTunesU, MyPod, ePodcast
7	Shared Documents	Google Docs, Zoho Writer, SlideShare, Elgg, Clearspace
8	Social Bookmarking	del.icio.us, CiteULike, Simple, Diigo, Connotea, digg, reddit
9	Social Networking	Facebook, MySpace, Bebo, Ning, LinkedIn
10	Subscribed Content Delivery	Google Reader, Bloglines, RSS Feeds
11	Synchronous Communications	Google Talk, iChat, CUworld, ICQ, Skype, Elluminate Live, MSN /Yahoo messenger
12	Virtual Worlds	Second Life (SL), Virtual Graffiti, eSimulations
13	Weblogs and Microblogs	Blogger, Wordpress, Twitter, RAMBLE, Yammer
14	Wiki	PBWorks, Wikispaces, MediaWiki, WikidPad, Zwiki

It should be noted that the broader categories of virtual learning environments (VLE), online learning

environments (OLE), and learning management systems (LMS) were excluded. The exclusions include products such as Blackboard, SAKAI, Moodle, Desire2Learn, AJAX. The rationale here was 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 in the study. Further, the use of such systems is usually prescribed by the institution and therefore educators do not have the opportunity of opting out of using them.

A search of selected journals (Table 2) was undertaken to explore the most recent uses of the e-technologies in higher 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). This paper presents the results from this review.

Table 2: Initial sources.

Selected journals	ISSN #	ERA* Rank
<i>ALT-J Research in Learning Technology</i>	0968-7769	A
<i>Australasian Journal of Educational Technology</i>	1327-7308	B
<i>British Journal of Educational Technology</i>	0007-1013	A
<i>Computers and Education</i>	0360-1315	A
<i>Educational Technology Research and Development</i>	1556-6501	A
<i>Higher Education Research and Development</i>	1469-8366	A
<i>Interactive Learning Environments</i>	1744-5191	B
<i>Journal of Higher Education</i>	1573-174X	A
<i>Research in Higher Education</i>	1573-188X	A
<i>Teaching in Higher Education</i>	1470-1294	A

\* Excellence in Research Australia

The focus of the encompassing project then moved from the review of the literature to the identification of expert users (academic staff) of the e-technologies within the University. Their knowledge and expertise of using these technologies was captured through interviews. Students who were

enrolled in classes in which the e-technologies were used were invited to participate in focus groups thereby enabling the expert views to be complemented by the students' perceptions of using these technologies. These parts of the project will be the subject of future papers.

### 3 REVIEW OF E-TECHNOLOGIES

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

#### 3.1 Assessment and Survey Tools

Tools for formative and summative assessment being used in higher 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 quiz built using Respondus, 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 and 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 and 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 VotApedia 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 and Lillis 2010).

#### 3.2 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 and 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 higher 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 and Coldwell, 2005). Klisc, McGill and 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 higher education 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 arena such as the mobile learning tool developed by Cavus and Ibrahim (2009) which encouraged language students to learn new words via their mobile phones.

### 3.3 Digital Repositories

This category covers a plethora of different content management systems and the search engines that index them. Digital repositories typical in higher 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 et al., 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 and 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 and Chau, 2009);
- As a medium for creating awareness of the importance of lifelong learning for students (Heinrich et al., 2007);
- Professionals who are required to provide evidence of competence and professional development (Kardos et al., 2009);
- Supporting and empowering women returning to employment (Herman and Kirkup, 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 and Rodriguez-Illera, 2009). Structure and organisation of ePortfolios should reflect the "messages" that the tool is bringing (Brandes and 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 (Bratengeyer, 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.

### 3.4 Management and 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, p. 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, Alamy and 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.

### 3.5 Photo Sharing

The use of photosharing websites has the potential to "open lines of dialogue, communication, and learning" (Fisher and 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 and 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).

### 3.6 Podcasts and Streaming

The term podcast is a contraction of iPod and broadcast. A podcast is an audio or video file (educational resources in this case) that can be created and made available for download from the Internet to a computer or mobile device that is capable of playing MP3 or MP4 files on demand. Most podcasts have RSS capability (see subscribed content) allowing users to automate the process of accessing recent additions. An alternative to podcasts are streamed files which contain data sent in a compressed format that is played in real time at the destination. Unlike podcasts, 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 iTunesU, podcasting was touted as the answer to learning anytime, anywhere and high profile universities made podcasts of lecture series freely available (McKinney et al., 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 and Clark (2009, p. 219) suggest that "the majority of students believe they gained learning benefits from podcasts and appreciated the flexibility of the medium".

### 3.7 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 (Southavilay et al., 2009). Shared document technologies such as Google Docs are considered particularly useful if or when an institution 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.

### 3.8 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, adding another level of complexity.

### 3.9 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 and 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 postgraduate distance learning students enhanced student's learning and insight.

Cloudworks is one social networking site specifically developed for educational purposes. Conole and Culver (2009) 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" (p. 779). 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 and 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 and Baird, 2006 - 2007); (Kolek and 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.

### 3.10 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 via an RSS file on the Web (Glotzbach et al., 2009) which an RSS 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, an email client 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 et al., 2009).

### 3.11 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 (Bliesener 2006); professional development for teachers (Chen et al., 2009); virtual assistants as online facilitators (Blignaut and Nagel, 2009); and supporting acquisition of study and literacy skills (De Fazio et al., 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 and 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 cross national and cultural boundaries (Harrison et al., 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.

### 3.12 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, task 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 et al., 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 (Twining, 2009). Second Life (SL) is by far the most popular MUVE and applications can be found in many disciplines and educational contexts (Twining, 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 and Sinclair, 2009); (Jarmon et al., 2009); or where these experiences would be too expensive to produce in real life (Wheeler, 2009). Twining (2009, p. 498) suggests that they are also “spaces which encourage playfulness and testing of boundaries”.

There are some concerns about the MUVE as a learning environment. “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 and Sinclair, 2009, p. 108). This finding is supported in the literature (Omale et al., 2009); (Warburton, 2009). Another concern is that educators are ill prepared to take advantage of these new technologies (Twining, 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 eSimulations 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 and Lenz, 2009).
- The creation of a virtual learning environment on CD that emulated a fire investigation activities scenario (Davies and Dalgarno, 2009).

- The utilization of a fictitious telecommunications organisation (website) as a context for engaging students in professional practice (Goold et al., 2006).

### 3.13 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 and 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 and Baird, 2006 - 2007).

Blogs can provide a shareable student writing space or be used as a mechanism to record a student’s progress. They can also 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 et al., 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 is known as microblogging (Skiba, 2008). 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 (Grosbeck and Holotescu, 2008); making announcements as well as collaborative story writing (Skiba, 2008); and enhancing the social, cognitive and teacher presence in an online course (Dunlap and 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.

### 3.14 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. As of 2012, Wikipedia had over 19 million articles from 85,000 active contributors in more than 270 languages.

Application of wikis in the academic context include fostering learning in students (Ruth and Houghton, 2009); the collaborative writing of a textbook by faculty and students (Ravid et al., 2008); as a tool to understand artworks (Buffington, 2008); and to improve report writing amongst students (Neumann and 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 traditionally published sources but acknowledges that a lack of peer reviewing does result in a lack of quality assurance and that authors can introduce bias.

## 4 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 and 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 with a full shut down of the product 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 et al., 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 2011, 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.

## 5 CONCLUSIONS

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” (p. 34).

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.

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