Web 2.0-Based E-Learning:
Applying Social Informatics for Tertiary Teaching

Mark J.W. Lee
Charles Sturt University, Australia

Catherine McLoughlin
Australian Catholic University, Australia

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Chapter 2
Understanding Web 2.0 and its Implications for E-Learning

Tony Bates
Tony Bates Associates, Canada

ABSTRACT

A whole new range of web-based tools and services now provides learners with the opportunity to create their own digital learning materials, personal learning environments, and social networks. What are the implications for the design of learning materials, workplace training, and accreditation of learners? This chapter focuses on integrating educational principles of virtual learning with the application of these new technologies. The argument is made that these tools provide an opportunity for new design models for education and training that will better prepare citizens and workers for a knowledge-based society. It rejects, though, the notion that these tools of themselves will revolutionize education and make formal institutions redundant.

INTRODUCTION

A whole new range of web-based tools and services, including but not limited to blogs, e-portfolios, virtual worlds, massively multiplayer online games (MMOGs), Really Simple Syndication (RSS), podcasting, and synchronous tools such as Skype and Elluminate, now provides learners with the opportunity to create their own digital learning materials, personal learning environments, and social networks. Some, such as Stephen Downes (2006), have argued that with these new tools,

> *Learning is centered around the interests of the learner … Learning is immersive—learning by doing—and takes place not in a school but in an appropriate environment (such as a living arts centre). (Slide 27)*

Downes argues that so far, the mainstream education system has either tried to ban these tools outright, or has tried to do what traditional educators have always done with technology,

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namely incorporate them into a classroom-based environment.

Although agreeing in many ways with Downes' position and arguments, this chapter recognizes the diversity of approaches to teaching and learning, and therefore offers an approach to the use of Web 2.0 tools that focuses on choice for both teachers and learners. The argument is made that these tools could facilitate new models of design for education and training that will better prepare citizens and workers for a knowledge-based society. The chapter rejects, however, the notion that the tools of themselves will revolutionize education and make formal institutions redundant, because many learners require structure and guidance. Furthermore, whatever organizational arrangements are made (or not made) to support learning, these new technologies need to be integrated with a variety of educational approaches if all learners are to be accommodated.

The term "Web 2.0" was coined by Tim O'Reilly in 2004. Wikipedia defines Web 2.0 as follows:

the changing trends in the use of World Wide Web technology and web design that aim to enhance creativity, communications, secure information sharing, collaboration and functionality of the web. Web 2.0 concepts have led to the development and evolution of web culture communities and hosted services, such as social-networking sites, video sharing sites, wikis, blogs, and folksonomies. ("Web 2.0," 2008, para. 1)

Web 2.0 is a neat term, reflecting a new version of the Web in the language of computer science. However, although the term describes new technologies that have emerged over the last few years, "Web 2.0" reflects as much a social as a technological development. At the same time, Web 2.0 has been given an educational twist, through the parallel term "E-learning 2.0" (Downes, 2005), which involves e-learning based on Web 2.0 tools. Therefore in this chapter, while addressing some of the social philosophy implicit in many discussions of Web 2.0, the focus is primarily on the educational functionality and implications of these new tools, and an attempt is made to situate them not only in a socio-philosophical context, but also in the context of economic development, and educational theory and practice.

While the terms "Web 2.0" and "E-learning 2.0" suggest a clean break from earlier applications of the Web, in education the differences, although significant, are due more to a gradual development and evolution of tools and teaching practice than a sudden "big bang." Indeed, there is cause for concern that the term "Web 2.0" has been hijacked to describe one particular application of second-generation web tools, while excluding other new web tools equally of value to education. Thus some understanding of the history of the application of information and communications technologies (ICTs) in education is important in order to provide the necessary context for understanding Web 2.0 in education.

E-LEARNING 1.01–1.02 (1978–2005)

One of the first recorded uses of the Internet for teaching is the use of computer-mediated communication systems (CMCS) at the New Jersey Institute of Technology in the 1970s (Hiltz & Turoff, 1978; Hiltz, 1986). This was a "blended" learning model, combining classroom teaching with online discussion between students and teacher. A variety of software programs to support computer-mediated communication (CMC) were developed in the 1980s. One of the most used at this time was CoSy, developed by the University of Guelph in Canada. An important feature of CoSy was that it enabled threaded discussion, that is, postings were linked directly to a specific previous posting to which the student or teacher was replying, rather than just being listed by the timing of the posting. In 1988, the author of the present chapter used CoSy as an instructor on *DT200: An Introduction to Information Technology*, a

second-year distance education course developed by The Open University in the UK, with 1,500 students a year (see Mason, 1989). This again was a blended model, but delivered wholly at a distance, with content provided mainly through specially designed printed material, audiocassettes, and broadcast television programs. CoSy was used to provide students with the opportunity to discuss issues raised in the other medium. Thus the use of computers for collaborative learning through discussion forums is not new. This could be described as "E-learning 1.01."

Up until 1990, educational applications of the Internet were limited mainly to email and discussion forums such as CoSy. It was difficult to store or send large amounts of content over the Internet, because of the narrow bandwidth available at the time to most users (56 Kbps using dialup modems), and the difficulty and cost of creating and transmitting large amounts of textual material. This limitation was removed by the development of the World Wide Web, the Wikipedia entry for which states:

Using concepts from earlier hypertext systems, the World Wide Web was begun in 1989 by English scientist Tim Berners-Lee, working at the European Organization for Nuclear Research (CERN) in Geneva, Switzerland. In 1990, he proposed building a "web of nodes" storing "hypertext pages" viewed by "browsers" on a network, and released that web in 1992. Connected by the existing Internet, other websites were created, around the world, adding international standards for domain names & the HTML language. ("World Wide Web," 2008, para. 1)

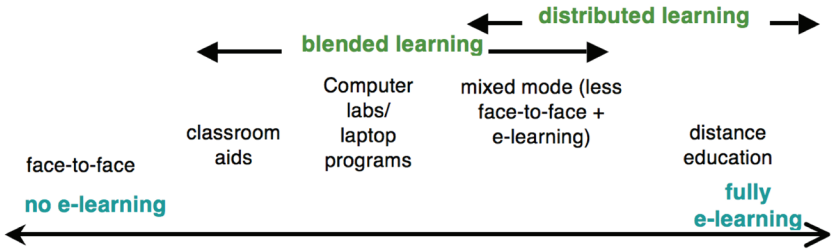
Initially, the importance of the Web was that it allowed large amounts of content (in particular, text and graphics) to be created, stored, searched for, and transmitted cheaply over the Internet, by breaking down the information into tiny packets and reassembling them again at the destination computer.

It took post-secondary education about three years to understand how the Web could be used for teaching and learning. Initially professors created their own web pages or online courses using hypertext markup language (HTML), then very quickly commercial products became established, providing teachers with "off-the-shelf" online learning environments that included "pages" for online course materials, tests and assignments, discussion forums, and access to other web-based resources. These are now called learning management systems (LMSs). WebCT was designed originally by Murray Goldberg at the University of British Columbia (UBC), and was one of the first LMSs. Subsequently, UBC sold WebCT to an American venture capital conglomerate, and in 2005 WebCT was bought over by its leading competitor, Blackboard. Over 90% of two- and four-year colleges in the USA had an LMS system in 2007 (Lokken & Womer, 2007).

At the same time, and partly in response to Blackboard's near monopoly now of commercial LMSs, there has been a move, particularly by large research universities and some government agencies, towards the development and implementation/use of open source LMSs, such as Moodle and Sakai. Gartner Research, based on the results of their 2007 Higher Education E-Learning Survey, estimated that open source LMSs constituted 26% of the market and that this was likely to grow to 35% by the end of 2008 (Lowendahl, Zastrocky, & Harris, 2008). Open source LMSs have the advantage of being free, in that, unlike commercial LMSs, there are no user license fees. However, by the nature of open source software, there are so far undetermined but nevertheless, according the 2007 Gartner survey, very real costs in installation, adaptation, and maintenance of open source LMSs, which have not yet been clearly identified.

Just as important as the use of LMSs has been the way the Web has been used to deliver teaching. In the *classroom aids* model, the teacher decides on the use of the computer, and uses it mainly to add to the classroom experience, for instance, by

Figure 1. Different forms of e-learning (from OECD, 2005; Bates & Poole, 2003)



providing a list of readings, lecture PowerPoints, assignment questions, and URLs to additional online resources.

With *laptop programs* (where the students bring their own or a leased computer to class), or programs using computer labs, where the institution provides the computers, the students and the teachers are active users of the computer, but still in a fixed-time-and-place classroom.

In the *mixed-mode (or hybrid) model*, students still spend some time in class, but class time is reduced to give students more time for online study. There are several versions of mixed-mode teaching, from dropping from three class sessions a week to one, with the rest done online, to the Royal Roads University (http://www.royalroads.ca/) model, where students study online before and after a semester spent on campus.

Lastly, there are courses where the student studies entirely online, which of course is one form of distance education. Figure 1, then, shows e-learning as a continuum. Note that blended learning can be any one of the three "middle" modes (Bates & Poole, 2003).

By far the greatest use of computer and communications technologies is to support—rather than replace—classroom teaching (80% of e-learning applications, according to Allen & Seaman, 2008). However, what is important here is the trend. More and more universities and colleges are now adding fully online courses. A study conducted for the American Association of Community Colleges found that 24% of all students were taking at least one fully online course in 2007. Some colleges were making it compulsory for a student to take at least one of their courses online before graduating (Lokken & Womer, 2007). Across the North American post-secondary system, fully online programs have been increasing by an average of 20% per annum since 2002 (Allen & Seaman, 2008).

Thus by and large we have two main forms of e-learning in post-secondary education, both based on the use of LMSs: blended learning—using a mix of classroom and face-to-face teaching (although the proportion may vary substantially)—and fully online learning. However, whether the Web is used as a classroom aid, or for blended learning, or for fully online courses, nearly all these applications are based on the use of an LMS. An LMS these days, whether commercial or open source, is a "heavy" piece of software, with a million lines of code or more. It is institutionally driven, linking teaching with administration. The teaching through an LMS is controlled by the instructor, who chooses content and activities, including the organization of the asynchronous online discussion forums. This is what Stephen Downes (2005) is referring to when he talks about "E-learning 1.0."

THE TOOLS OF WEB 2.0 (2005–)

Around 2005, a new range of web tools began to find their way into general use, and increasingly into educational use. These can be loosely described as Web 2.0 tools, as they reflect a different culture of web use from the former "centre-to-

Table 1. Examples of Web 2.0 tools

Type of tool	Example(s)	Application
Blogs	• Stephen's Web (http://www.downes.ca/)	Allows an individual to make regular postings to the Web, e.g., a personal diary or an analysis of current events
Wikis	• Wikipedia (http://en.wikipedia.org/)	An "open" collective publication, allowing people to contribute or create a body of information
Social networking	• Facebook (http://www.facebook.com/) • MySpace (http://www.myspace.com/)	A social utility that connects people with friends and others who work, study, and live around them
Multimedia archives	• Podcasts • YouTube (http://www.youtube.com/) • Flickr (http://www.flickr.com/) • iTunes • e-portfolios	Allows end-users to access, store, download, and share audio recordings, photographs, and videos
Synchronous communication tools	• Skype • Elluminate • Adobe Connect	Allows free "real-time" audio and visual communication over the Web
3-D virtual worlds	• Second Life (http://secondlife.com/)	Real-time semi-random connection/ communication with virtual sites and people
Multiplayer games	• Lord of the Rings Online (http://www.lotro.com/)	Enables players to compete against or collaborate with each other or a third party/parties represented by the computer, usually in real time
Mobile learning	• Mobile phones • Ubiquitous computing devices and applications	Enables users to access multiple information formats (voice, text, video, etc.) at any time, any place
Open content	• MIT OpenCourseWare (http://ocw.mit.edu/)	Digital learning materials available free over the Internet, for use either by instructors or learners

periphery" push of institutional websites. Table 1 shows some of the tools and their uses (this is, of course, by no means an exhaustive list—there are many more possible examples).

The main feature of Web 2.0 tools is that they empower the end-user to access, create, disseminate, and share information easily in a user-friendly, open environment. Usually the only cost is the time of the end-user. There are often few controls over content, other than those normally imposed by a state or government (such as libel or pornography), or where there are controls, they are imposed by the users themselves. Some have called Web 2.0 the "democratization" of the Web.

In general, Web 2.0 tools are based on very simple software in that they have relatively few lines of code. As a result, new tools are constantly emerging, and their use is either free or very low cost. However, not all the new tools developed since 2005 are social software tools, and not all are free or low cost (e.g., many commercial games).

Web 2.0 tools have proved increasingly popular in both social and business applications. One feature of such tools is to empower the end-user—the learner or customer—to self-access and manage data (e.g., online banking) and to form personal networks (e.g., through Facebook).

EDUCATIONAL APPLICATIONS: E-LEARNING 2.0?

Web 2.0 tools are so relatively new to education that educators have yet to find new designs for

teaching and learning that fully exploit such tools. Most uses to date have been within the framework of a teacher-controlled model of instruction. For instance, teachers may add their own blog to an online course, or encourage students to chat or work offline then post their work back in the "teaching" area. They may use Elluminate to deliver a live lecture with slides, or a podcast to catch an update from a visiting expert, or to transmit a recorded classroom lecture. Note that Web 2.0 tools can be used quite independently of an LMS (although they can also be made available within or in parallel to an LMS). Nevertheless, there are now an increasing number of examples of teaching and learning using Web 2.0 tools that exploit the learner's capacity to access, create, and publish materials.

Social and Collaborative Networking

The first Internet educational tool, well preceding the invention of the Web, was discussion software that allowed multiple users to discuss asynchronously online in a common, if virtual, area (CMC—see Hiltz, 1986). This technology has gradually evolved through discussion forums into community-based collaborative networks. Social software, such as discussion forums, allows students to test, question, and construct their own, personalized knowledge.

In the personal networking areas, there are several tools that "are fostering collaboration webs that span almost every discipline … [Collaborative workspaces] are easy to create, and they allow people to jointly collaborate on complex projects using low-cost, simple tools" (New Media Consortium, 2008, p. 14). These collaborative workspaces serve as hubs where groups of people with common interests can gather and share resources—such as relevant references or publications—related to their interests.

Multimedia Archives

Multimedia archives such as YouTube, Flickr, and Google Video, and the increasing access to cheap digital video cameras or integrated video and audio recording in mobile phones, now enable learners to create their own digital e-portfolios of work, incorporating text, graphics, audio, and video. These tools again are relatively simple to use. YouTube, for example, provides a video toolbox (see http://www.youtube.com/video_toolbox/) that includes a set of guidelines for producing good-quality video material. Posting video to sites such as YouTube is free, quick, and easy.

This means that learners can now go out and do local fieldwork, and create digital multimedia web-based portfolios of their work, either individually or collaboratively (see Lorenzo & Ittelson, 2005). This raises questions regarding online assessment as well as the design of teaching and learning experiences (see Joint Information Systems Committee [JISC], 2007; see also Chapter 17). Learners can demonstrate what they are able to do and what they have learned, record their experiences, and allow others—such as potential employers—to access their work.

Synchronous Technologies

The case could be made that tools such as Elluminate that allow synchronous two-way communication (mainly audio, supplemented with graphics such as PowerPoint) and Skype are not "authentic" Web 2.0 tools. This is because they are most commonly used to reflect the "old" paradigm of an instructor giving a lecture, and are also more expensive to use than social software such as blogs, wikis, or social networking sites (e.g., Facebook). However, synchronous communication tools take advantage of improved compression technology and wider bandwidth capacity, and can also be organized and managed by end-users or learners for communication. Certainly for certain educational tasks such as learning a language,

these tools provide much more flexibility than the previous generation of web tools.

Virtual Worlds

Virtual worlds (or Massively Multiplayer Virtual Worlds—MMVWs) are complex digital environments that allow participants to project a non-physical presence of themselves—an *avatar*—into a generated three-dimensional (3-D) reality, and within that reality to interact with other participants. Users can build and modify this world to a large degree. Second Life (SL) is the best-known virtual world with the largest number of users. Senges, Praus, and Bihr (2007) reported six million accounts in SL in 2006. By June 2008, this had grown to 14 million accounts (Parsons, 2008), although active accounts are much fewer.

Senges et al. (2007) identified a number of educational applications of SL (see Kay & FitzGerald, 2008 for a detailed list of educational applications of SL). The National Oceanic and Atmospheric Administration has built immersive environments where participants can virtually experience tsunamis and simulated weather fronts, combined with explanations about the causes and strategies to reduce harm (see Earth System Research Laboratory, 2008). Hydro Hijinks, developed by students at Montgomery College, USA, is a diplomacy adventure game set in a scenario where farmers are suffering a water shortage, and players have to discover the cause of the water shortage (see morebrainsmedia, 2006).

More recently, Cigna Healthcare has created a virtual environment in SL to educate people on how to improve their health. Like many insurance companies, Cigna offers healthcare advice to those it insures as an attempt to keep its long-term costs lower and its insurance rates more affordable. The Cigna Virtual Healthcare Community is an "island" in SL where users can walk through 3-D interactive displays with their avatars, play educational games, listen to seminars on nutrition and health, and receive virtual health consultations (Takahashi, 2008). There are several projects in SL in the language learning domain, involving the creation of environments where learners can practice languages and meet other foreign language speakers. Several architectural projects have used SL for collaborative design (see, for instance, Studio Wikitecture at http://studiowikitecture.wordpress.com/). Robert C. Amme, a research professor of physics, and his colleagues at the University of Denver received a $200,000 grant from the U.S. Nuclear Regulatory Commission to build a simulated nuclear reactor to train the next generation of environmental assessment specialists (Guess, 2007).

The relative novelty of SL means that there are as yet no well-established educational designs for exploiting the uniqueness of the virtual world. Some merely replicate traditional classroom practice. It is also not yet possible to build a business model that will set costs against benefits. It is thus still very much an experimental environment for learning (Senges et al., 2007). Nevertheless, especially with such a large potential number of participants, a learner in SL is presented with a wide array of learning opportunities, enabling knowledge to be constructed through a combination of social interaction, collaboration, exploration, and experimentation, in real time.

Digital Games

There have been major advances in games technology over recent years. A few games have been designed or adapted for educational purposes ("serious gaming environments"), mainly for the K-12 sector (Prensky, 2006). However, educational games to date have had limited application and utility, mainly because of the high cost of development and lack of appropriate and sound instructional design (Burgos, Tattersall, & Koper, 2007).

Nevertheless, there is strong potential for taking some of the building blocks of games technology, such as "off-the-shelf" software for

scenery animation, hand–eye coordination, and crowd behavior, and adapting them to educational purposes, thereby cutting down the cost of building all software from scratch.

Mobile Learning

Worldwide, more people have mobile phones than personal computers. Green (2007) reports that more than two-thirds of all classes in North American colleges now have wireless access. The rapid expansion of wireless technology has stimulated interest in mobile learning—delivery of education and training to people on the move.

Mobile learning has been developed in a number of ways. The simplest is the use of RSS feeds to alert students to course news and information, such as the imminent deadline for the next assignment. However, as mobile technology has become more sophisticated, with larger, clearer screens, touch-controlled keyboards, and motion-controlled navigation, the potential for educational applications has also increased.

One major application is to use mobile phones for student data collection, in the form of real-time polling and interviews, photographs, and video for project work, etc. that students can then organize and post on a class website (Alexander, 2004; JISC, 2005). (See also Chapter 10 in this book, on "Mobile 2.0.")

Open Content

Another major development has been the move to digital open content. Institutions such as the Massachusetts Institute of Technology (see the MIT OpenCourseWare initiative at http://ocw.mit.edu/) and The Open University in the UK (see the OpenLearn website at http://openlearn.open.ac.uk/) have been making available their educational content free of charge for educational purposes. Intellectual property management, and recognition of instructors' contribution to content creation, has been managed through cooperative copyright management sites such as Creative Commons (http://www.creativecommons.org/), which allows instructors to make available content with some protection against improper or commercial use.

The move to more open content has several implications. Teachers and learners now have an increasing range of quality-assured learning materials that they can access, free of charge, for educational purposes. Teachers no longer need to create all their own material online; learners are no longer restricted to the content and curriculum provided by the university or college at which they are enrolled. Thus one can imagine an "open content" approach to a subject, where the instructor is a guide, providing goals and criteria for assessment, but where the students track down, assess, and organize appropriate learning materials.

Educational Implications of the New Web 2.0 Tools

Learners now have powerful tools for creating their own learning materials or for demonstrating their knowledge and skills. Courses can be structured around individual students' interests, allowing them to seek appropriate content and resources to support the development of negotiated competencies or learning outcomes. Content is now open; learners can go and seek, use, and apply information beyond the bounds of what a professor or teacher may dictate. Increasingly, quality educational content will become free, open, and abundant. Students can create and customize their own online personal learning environments (see also Chapter 5 in this book).

This represents a major power shift from teachers to learners. Some commentators (e.g., Downes, 2006) have argued that traditional institutions such as schools and universities are now no longer needed for learning purposes, as the tools of Web 2.0 allow learners to control what and how they learn. The idea of abolishing schools of course is not a new idea—Ivan Illich (1973)

wrote about deschooling and learning webs long ago—but the Internet multiplies infinitely the number of connections an individual may now make to the point where it becomes much easier for those who wish to learn this way to do so. Supercool School (http://www.supercoolschool.com/) now uses Facebook to network learners with a common interest who teach themselves: no curriculum, no formally appointed teachers, and no examinations.

However, although the technology continually changes, some things do not. Many of the services that educational institutions currently provide—such as guidance, learner support, and accreditation—will still be needed. Many students are not, at least initially, independent learners (see Candy, 1991), and many deliberately seek guidance and help from teachers and institutions. One reason we have educational institutions that are supported by the public is because, to quote former U.S. Secretary of Defense Donald Rumsfeld (2002), "there are known unknowns; that is to say we know there are some things we do not know." This is one reason why students choose to go to university, or why parents send children to school. Many students come to a learning task without the necessary skills or confidence to study independently from scratch (Moore & Thompson, 1990). They need structured support, structured and selected content, and recognized accreditation. The advent of new tools that at last give students more control over their learning will not change their need for a structured educational experience. However, learners can be taught the skills needed to become independent learners (Moore, 1973; Marshall & Rowland, 1993). The new tools will make this learning of how to learn much more effective, but still only, in most cases, within an initially structured environment.

At the same time, research by the Sloan Consortium, which found that over 80% of online teaching in the USA was performed to support traditional classroom teaching (Allen & Seaman, 2006), suggests that most teachers working online are not changing their teaching method sufficiently to make full use of the new Web 2.0 tools. One reason is that institutions are locked into supporting LMSs such as Blackboard or Moodle. Even more importantly, most instructors are locked into a classroom-based, 9:00–4:00, five-days-a-week, 13-weeks-a-year semester system—essential for classroom teaching, but meaningless in a fully online environment. For many students, this structured education is necessary, even when they begin to move online, and such tools as LMSs also have administrative advantages like linking student records to teaching activities. Nevertheless, this mode of teaching does not empower learners in the way that some of the newer Web 2.0 tools can. Downes (2006) argues that these new tools allow for *immersive* learning—learning everywhere and at any time, within all aspects of life, without the need for formal, time-and-place-dependent institutions.

The use of Web 2.0 tools raises the inevitable issue of quality. How can learners differentiate between reliable, accurate, authoritative information and inaccurate, biased, or unsubstantiated information, if they are encouraged to roam free? What are the implications for expertise and specialist knowledge, when everyone has a view on everything? As Andrew Keen (2007) has commented, "we are replacing the tyranny of experts with the tyranny of idiots." Not all information is equal, nor are all opinions. Unless we are to descend into subjective, quarreling beasts (the tyranny of idiots, as expressed by Keen), expertise remains critical for progress. Many students look for structure and guidance, and it is the responsibility of teachers to provide it. A middle ground is therefore needed between the total authority and control of the teacher, and complete anarchy as seen in the children roaming free on the desert island in the novel *Lord of the flies* (Golding, 1954). The new Web 2.0 tools allow for such a middle ground, but only if teachers have a clear pedagogy or educational philosophy to guide their choices and use of the technology.

The point here is that the choice of technology and the design of the learning experience is an academic decision that will vary depending on the type of students being taught and the nature of the subject. However, perhaps the most important factor determining choice of the actual tools to be used in online learning will be the educational theory or approach (the pedagogy, for want of a better term) most favored by those responsible for the teaching or learning.

DIFFERENT PEDAGOGICAL APPROACHES TO WEB-BASED LEARNING

There are many different theories of learning, and most of these theories reflect underlying but different philosophical beliefs about the nature of knowledge (epistemologies). This is a large and complex topic and can be dealt with only briefly in this chapter. For a good discussion of the overall epistemological issues raised by ICTs, see Lyotard (1979/1984) and Lankshear, Peters, and Knobel (2000).

It is necessary here to make a distinction between epistemologies and theories of learning. An epistemology basically describes the basis on which we know or believe something to be true. This can be illustrated by the famous debate between Thomas Huxley and Bishop Wilberforce in 1860 on the origin of man. Huxley argued that man was descended from the apes, based on Darwin's work on the origin of species. Huxley's argument was in the form of a scientific theory grounded in empirical evidence. Wilberforce argued that man was created by God, based on evidence from the Bible. The basis for their beliefs were by and large irreconcilable, because they started from fundamentally different views of what constitutes "evidence" for their belief. There are many different epistemologies, including rationalism (based on logic), objectivism (empirically tested knowledge), scholasticism (authorized interpretation of historical sources such as the Bible or Qur'an), and constructivism.

A theory of teaching or learning will be strongly influenced by one or more epistemological positions. However, an epistemology does not in itself address issues of teaching or learning. Learning or teaching theories are applications of a more general set of epistemological positions or beliefs about the nature of knowledge. Thus behaviorism is an approach to teaching and learning reflecting an objectivist epistemology, but then so are some forms of cognitive psychology or artificial intelligence.

Three epistemologies will be dealt with here—objectivism, constructivism, and connectivism—that are relevant to the application of Web 2.0 tools. It should be noted, however, that there are other epistemologies that could be applied. The point here is that it is important for teachers to be aware of different epistemologies and to be sure that their use of Web 2.0 tools is consistent with their own preferred epistemological positions.

Objectivism

An objectivist view of knowledge is that truth exists outside the human mind. In particular, there are undeniable facts, concepts, and principles that are constant, reflecting an unchanging reality, and independent of personal beliefs (Popper, 1972). Scientific laws are examples of an objectivist approach to knowledge. Whatever one may happen to believe, there is a law of gravity. The apple will fall downwards, at a certain speed that is predictable with enough known "facts."

For teachers who hold an objectivist position, there is a body of knowledge to be learned and defined by experts. This is organized into subject disciplines or content areas. The job of the teacher is to transmit that body of knowledge. Teaching is about moving knowledge from those that know to those that do not know. The learner's task is to understand, memorize, reproduce accurately what has been learned, and perhaps apply that

knowledge to specific, well-defined contexts. Good teaching is authoritative, correct, well organized, clear, and not to be questioned. Learning is assessed by the production of correct answers and efficient reasoning based on the facts and concepts taught in the course. Objectivist teaching can be found in all subject areas, but for obvious reasons it is particularly strong in the natural sciences, computer sciences, engineering, and law. Objectivist instructional design is based strongly on behavioral approaches, systems thinking, and quantitatively measured outputs (see, for instance, Dick & Carey, 1996).

Constructivism

Constructivists believe that all knowledge is a human construct (Gould & Brown, 2003). Even the laws of science are what scientists believe at a particular time, and are open to change as a result of not just new facts, but also new ideas, and agreement is reached through discussion. Particularly important to constructivists is that all knowledge is relative, personal, and dynamic. For instance, the concept of heat is understood early in life through sensation. A baby learns about heat by touching something hot, like a stove. As the child grows older, he or she realizes that heat is relative, and can be quantified. For a child in Vancouver, a daily temperature of 30 degrees Celsius is hot, and a temperature of minus 30 is cold. However, this is not true for a child in Riyadh or one in Iqualuit, where the concepts of a hot or cold day are quite different. As the child gets older, he or she may learn that heat is the transfer of energy between two objects due to temperature differences. Thus the concept of heat is dynamic, relative, and personal. One person's understanding of heat will be different from that of another, because their experiences are different. There may be enough shared understanding of heat for them to agree on what it is, but their understandings of it will not be quite the same.

For constructivists, teaching is about observation, comparison, questioning, reflection, discussion, and above all, the assimilation and accommodation of new experiences with previous forms of understanding. This is done through reflection (internal contemplation) and discussion. Discussion, in particular, is important, because this is how we test and challenge new ideas or unfamiliar concepts. Thus learning is both a personal and a social activity.

The teacher's job is to create an environment in which questions are raised, problems are presented for solution by the learners, and discussion and argument can take place. In this environment, learners are more equal in that they are encouraged to challenge not only other learners but also the teacher. Assessment is based on the quality of argument or reasoning, not the reproduction of facts or concepts. Constructivist approaches to teaching and learning are also found in all subject areas, but are more common in the humanities, social sciences, and education. (See Jonassen, Davidson, Collins, Campbell, & Bannan Haag, 1995 for a discussion of how constructivism can be applied to online learning.)

Connectivism

Connectivism is a theory advanced by George Siemens (2005). A connectivist view of knowledge is that the nature of knowledge is radically transformed by the technology of the Internet. Lyotard (1979/1984), for example, has argued that the nature of knowledge derived from the use of information technologies is radically different from the knowledge derived through scientific thinking. According to Lyotard, knowledge derived from science and rationalism has an intrinsic value, whereas knowledge in the information society has a commercial or utilitarian value. Siemens argues that knowledge is advanced and transformed by the contributions of those connected to particular networks, which are in turn connected to other networks (collective intelligence). The

interconnectedness of people through the Internet allows for the learning that occurs overall to be greater than the learning of each individual connected (the "wisdom of crowds"—Surowiecki, 2004). For Siemens, it is more important to be connected to the "right" nodes to "catch" new knowledge than to be outside the network with "old" knowledge, or connected to networks that are less "useful". According to him, "Nodes that successfully acquire greater profile will be more successful at acquiring additional connections" (p. 6); "The pipe is more important than the content within the pipe" (p. 8). Thus knowledge is constantly shifting and changing. Recognizing patterns within the chaos of shifting knowledge is a core skill to be learned, as is recognizing the networks of connections that matter.

Although he describes it as a theory of learning, and his ideas certainly have profound implications for teaching and learning, Siemens' position is more of an epistemology—a view of the nature of knowledge—than a theory of teaching and learning. Thus there are hints of possible actions to be taken, but at this stage of development, there are no clear guidelines for teachers and learners. However, Web 2.0 tools and practices will likely be critical elements of any teaching or learning that is consciously built around the concept of connectivism.

Choosing Epistemological Positions

Teachers are always making choices about how to teach based on their views of what constitutes knowledge, and the best means to help learners acquire that knowledge. Frequently teachers will use a variety of approaches, depending on the nature of the subject matter and the needs of individual learners. For instance, an objectivist, didactic approach—delivering information in a well-structured and organized way—may be necessary to get learners quickly to a position where they can start asking questions or solving problems in a more constructivist manner. Nevertheless, the design of teaching will be influenced by the dominant epistemological position of teachers, and this will need to "match," to some extent, the needs of learners. It is important, then, to ensure that learners are developing the skills and competencies they will need in the "outside world," which brings the discussion to the teaching and learning needs of a knowledge-based society. In particular, this will provide some guidance on the appropriate choice and use of Web 2.0 tools.

LEARNING IN A KNOWLEDGE-BASED SOCIETY

In any country, there are at least three somewhat different economies operating at the same time (Porter, 1990):

- *Resource-based economies:* These are primarily land- and sea-based economies: agriculture, mining, fishing. Increasingly over time, they have become more knowledge-based, but the majority of workers in these industries have learned their skills in traditional ways, either from relatives or on the job. The numbers working in these industries in economically advanced countries has rapidly declined, even though in countries such as Canada and Australia resource-based economies still are major contributors to gross national product (Smith, 2007). Nonetheless, they employ relatively few workers, because the number of workers in relation to economic output is very low, due to innovation, mechanization, and the high value of the goods produced per worker.
- *Industrial-based economies:* These are based primarily on manufacturing, that is, converting the raw materials of the resource-based industries into goods through factories. Such economies are mainly urban. Labor is a major cost, and economies

of scale—manufacturing the same product many times—is essential, because of the high fixed cost of equipment. The organization of labor is mainly hierarchical, with owners, managers, supervisors, skilled workers, and unskilled workers. Skilled workers are relatively narrowly trained within a specific occupation; only the owners and managers require advanced levels of education, although as manufacturing becomes more automated, labor costs are reduced and knowledge and skill levels for some workers increase. In spite of the above, even industrial-based companies now are relying more and more on knowledge-based products and services. For instance, Volkwagen estimates that 70% of the value of a modern car is knowledge-based, mainly in the form of its electronic systems and the costs of research and design. In the past, manufacturing provided large numbers of workers with steady work and relatively high wages.

- *Knowledge-based economies:* These are primarily based on the production, transmission, management, and organization of information, mostly digital information (Drucker, 1969). Typical knowledge-based industries are telecommunications, financial services (banking, insurance), health services, entertainment (movies, games), biotechnology, information technology companies (computing, etc.), and education. These economies are "virtual," that is, they are not dependent on a particular, single location (although companies operating in them may have headquarters), they are global, and they require workers with a high level of education and multiple skills. Often, knowledge-based companies are small, with between two and 100 employees. They are networked to other organizations, highly flexible, and emerge, combine, and disappear very quickly, although in some areas there are dominant industry players (e.g., Microsoft, Google).

Over time, there has been a significant shift in economies (Porter, 1990). Because labor is a major cost in industrial organizations, manufacturing has been moving from high-cost labor markets to lower-cost labor markets. To retain their global competitiveness, economically advanced countries have been switching from industrial-based to knowledge-based economies. Their advantage is that knowledge-based industries require workers with high levels of education and knowledge, which countries such as Canada and the USA, with over 50% of an age group going on to some form of post-secondary education, have in abundance. It should be noted though that the skills of knowledge-based workers are markedly different from those of industrially based workers, except at the senior management level. Thus the shift to a knowledge-based economy is dependent on large numbers of highly educated workers with different skills from those of industrially based workers (Conference Board of Canada, 1991).

The shift in economies has been quite dramatic. Figure 2 and Figure 3 show this effect on employment in Canada. Figure 2 shows the division of the workforce between the three economies from the middle of the 19th century to the present day. Before 1850, nearly 80% of jobs in Canada were based on working the land and sea. As the Industrial Revolution impacted on Canada, many people left the countryside and migrated to jobs in factories. Between the 1930s to around 1985, nearly 75% of employed Canadians worked in manufacturing (Marcus, 1952).

Figure 3 shows a dramatic change in Canadian employment from 1985 onwards. Manufacturing jobs in Canada have dropped from nearly 75% in 1985 to under 15% by 2007. They have almost entirely been replaced by jobs in the service sector. The service sector hides, though, the important dif-

Figure 2. Shifting jobs: Canada

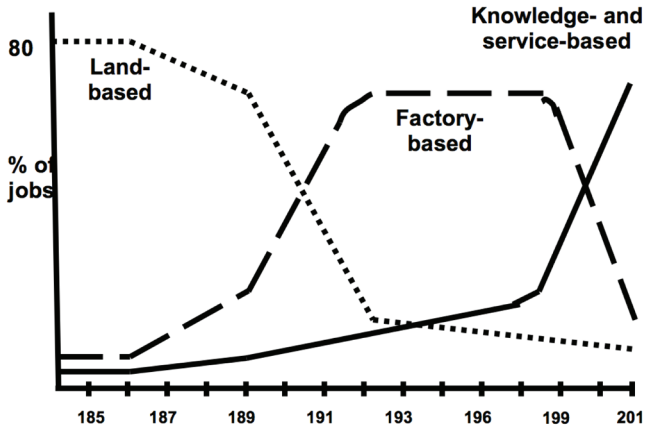
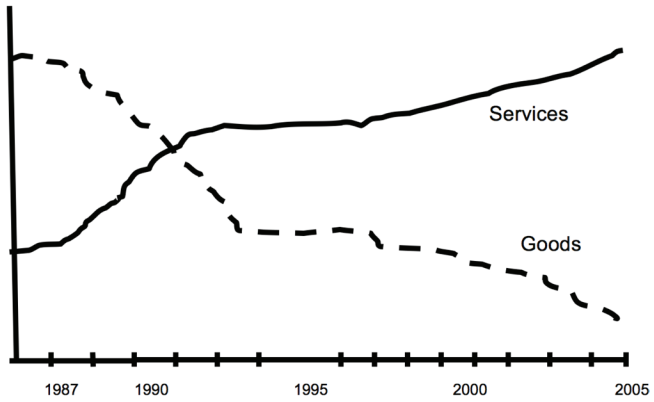


Figure 3. Percentage share of Canadian industrial employment (Source: The Globe and Mail, April 27, 2006, B9)



ferences between high-paying knowledge-based jobs and low-paying, unskilled or semi-skilled service jobs (e.g., shop assistants). Nevertheless, despite this huge drop in manufacturing jobs, Canada's unemployment rate is at an all-time low, and its economy has been booming (Note that the figures reflect the proportion of jobs in each sector, *not* the proportion of gross domestic product [GDP]. The resource sector—mining and oil in particular, which are land-based—is a major contributor to Canada's GDP, but employs relatively few people.)

Although the timing and magnitude of the change may vary, similar patterns will be found in many other economically advanced countries (according to the *Financial Times* in the UK, for example, the British economy reached the "cross-over" point between employment in goods and services in 2008 [Laitner, 2008]). The reason is that manufacturing jobs have migrated to countries with low labor costs. However, much of the value of goods produced in low-labor economies is created (and retained) in economically advanced countries. For instance, the Conference Board of Canada (2008, p. 2) states that

Every US$300 Apple iPod adds $150 to the official U.S. imports from China, but only $3 of its

value is actually created in China. About $147 is created in the rest of Asia, and another $149 in the United States.

The point here is that economically advanced countries are increasingly depending on knowledge-based workers to maintain and increase their standard of living. In an industrial society, less than 15% of those in the workforce (mainly owners, managers, and those working in financial services) needed post-secondary education. In knowledge-based economies, more than 50% need post-secondary education (the Alberta Provincial Government, 2008 has put this figure at 62.7% of all jobs by 2011).

Education therefore needs to be focused particularly on the knowledge and skills required in knowledge-based companies. What are those skills? The Conference Board of Canada (1991) surveyed employers in knowledge-based companies and identified the following:

- good communication skills (reading/writing/speaking/listening);
- ability to learn independently;
- social skills: ethics, positive attitudes, responsibility;
- teamwork;
- ability to adapt to changing circumstances;
- thinking skills: problem solving; critical/logical/numerical;
- knowledge navigation: where to get/how to process information;
- entrepreneurial skills: taking initiative to seize an opportunity;
- IT and computing skills.

It might be argued that these are not very different from the kinds of skills one would expect from any traditional liberal arts program. The catch, though, is that these skills are required *in addition to* specialist qualifications in engineering, management, health sciences, business, etc. It will still be essential to build the foundations of knowledge in these areas, such as mathematics, accountancy, anatomy, etc. Furthermore, skills such as problem solving are not generic: problem solving in medicine is different from problem solving in business. The skill needs to be embedded within the content area. This means teaching content and designing learning activities in such a way as to develop these skills.

A second feature of knowledge-based work is that knowledge workers must continue to go on learning (Senge, 1990). The knowledge bases of medicine, IT, and biotechnology, for example, are constantly changing. To stay competitive, knowledge-based companies and their employees must continually change and adapt through a process of lifelong learning. Thus universities and colleges face two challenges: with regard to those entering from high schools, how to develop the thinking skills identified as needed within a knowledge-based society within a traditional undergraduate program; and equally as important, how to provide ongoing opportunities for learning for those who have already graduated and are in the workforce.

This is where the epistemological basis for teaching and learning becomes critical. Constructivism, with its emphasis on learner-centered teaching, discussion, and communication between learners, and connectivism, with its emphasis on Internet-mediated knowledge construction and digital literacy, seem to provide a better basis for developing the skills needed in knowledge-based economies than what is possible with a predominantly objectivist approach. Noteworthy, however, is Lyotard's (1979/1984) observation about the changing nature of knowledge as having commercial rather than intrinsic value in a knowledge-based society.

CHANGING STUDENTS

In discussing the topic of changing students, it may be useful to begin with a warning from a

study commissioned by the British Library and JISC, the UK universities' computer network organization. The study used log file analysis of actual search behavior of a wide range of users of different ages (Centre for Information Behaviour and the Evaluation of Research [CIBER], 2008):

There are very, very few controlled studies that account for age and information seeking behavior systematically: as a result there is much misinformation and much speculation about how young people supposedly behave in cyberspace. (p. 14)

Nevertheless, Marc Prensky (2001) claims:

Our students have changed radically. Today's students are no longer the people our educational system was designed to teach ... today's students think and process information fundamentally differently from their predecessors. (p. 1)

He argues that students now entering university have grown up all their lives with technology—mobile phones, computers, video games, and so on—and therefore are "digital natives." As a result of this exposure to technology, digital natives access and process information more quickly, multitask more easily, prefer graphics to text and random to sequential access, thrive on instant gratification and rewards, and prefer games to serious work. This makes them different from "digital immigrants," that is, people who did not grow up with this technology, but have learned to adapt to it later in life. As a result, according to Prensky, educational institutions need to change their approach to accommodate the needs of such learners, but it is difficult for most teachers to do this, since they are digital immigrants, not natives.

It is certainly true that many digital natives are early and heavy adopters of Web 2.0 tools such as MySpace, Facebook, YouTube, and Twitter. These mesh well with their prior experience and needs. However, there is little research or systematically collected empirical evidence at this stage that the skills digital natives have developed in their personal and social lives carry over into academic work. Laurillard (2002, p. 218) points out, for instance, that

academic knowledge is distinct from experiential knowledge. It is a reflection on experience, rather than being synonymous with experience per se. It also includes knowledge of how that knowledge came to be known.

The British Library/JISC study (CIBER, 2008) looked at the "Google generation," defined as those born after 1993, and asked the following question (among others) in relation to this generation: "[Are they] searching for and researching content in new ways and … [is this] likely to shape their future behaviour as mature researchers?" (p. 5). This study reported that

young people scan online pages very rapidly (boys especially) and click extensively on hyperlinks—rather than reading sequentially. Users make very little use of advanced search facilities, assuming that search engines "understand" their queries. They tend to move rapidly from page to page, spending little time reading or digesting information and they have difficulty making relevance judgments about the pages they retrieve. (p. 14)

Although this somewhat supports Prensky's position, the CIBER study goes on to challenge a number of apparent myths about "digital natives," with varying degrees of confidence. However, one point they do make clearly is that

the evidence indicates that more people across all age groups are using the Internet and Web 2.0 technologies widely and for a variety of purposes. The young... may have been the earliest adopters but now older users are fast catching up... the so-called Silver Surfers. In many ways the Google generation label is increasingly unhelpful. (p. 21)

The study concludes:

much writing on the topic of this report overestimates the impact of ICTs on the young and underestimates its effect on older generations. A much greater sense of balance is needed. (p. 21)

This empirical study reinforces a few—and challenges many—of the assumptions made by Prensky (see also Chapter 16 in this book for a further, critical examination of the "digital natives" concept). The CIBER study identifies that young people's use of Google is relatively superficial, and does not lead to deep processing of information. Thus, although young people may enter post-secondary education with familiarity of new technologies, they may not necessarily know how best to use it for academic purposes. From this perspective there is still an important role for teachers. On the other hand, bearing in mind Siemens' (2005) aforementioned view that the pipe is more important than the content, young people's fast and voluminous searching behavior may nevertheless be important in its own right in a networked world.

The issues, then, are (1) to what extent new technology requires a re-examination of the fundamental principles and beliefs that underpin academic study, so as to accommodate to the exigencies of a networked society; and (2) to what extent the non-academic technology behavior of young people can be harnessed for more traditional academic study. Because different teachers will come to different conclusions about these issues, it is necessary to provide some way of analyzing the potential educational use of Web 2.0 tools, and this needs to be done by linking it to different epistemological positions that teachers may adhere to.

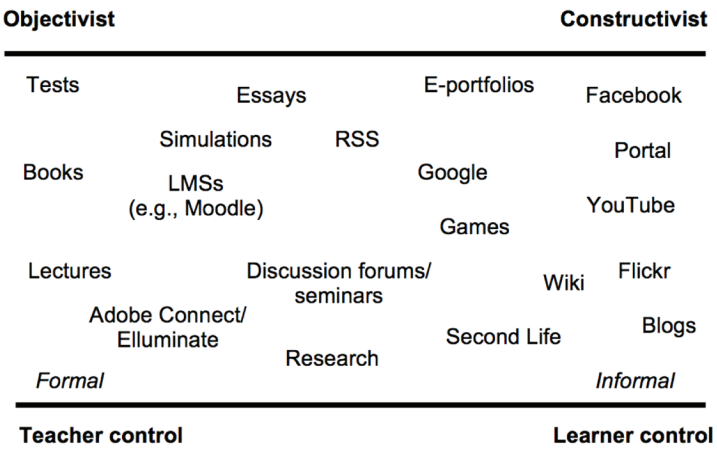
ANALYZING WEB 2.0 TOOLS FROM AN EDUCATIONAL PERSPECTIVE

Figure 4 presents a diagrammatic analysis of various e-learning tools. This represents the author's personal interpretation of the tools, and other teachers may well rearrange the diagram differently, depending on their particular applications of these tools. The position of any particular tool in the diagram will depend on its actual use. LMSs can be used in a constructivist way, and blogs can be very much teacher controlled if the teacher is the only one permitted to use a blog on a course, for example. However, the aim here is not to provide a cast-iron categorization of e-learning tools, but simply to offer a framework to assist teachers in deciding which tools are most likely to suit a particular teaching approach. Indeed, other teachers may prefer a different set of pedagogical values as a framework for analysis of the different tools.

However, to give an example from Figure 4, a teacher may use an LMS to organize a set of resources, guidelines, procedures, and deadlines for students, who then may use several of the Web 2.0 tools, such as YouTube, to collect data. The teacher provides a space and structure within the LMS for students' learning materials in the form of an e-portfolio, into which students can upload their work. Students in small groups can use the discussion features in Facebook to work on projects together. Note that this figure also permits traditional teaching modes, such as lectures and seminars, to be included and compared.

It can be seen that Web 2.0 tools now enable teachers to set online group work, based on cases or projects, and students can collect data in the field, without any need for direct face-to-face contact with either the teacher or other students. Learners can access learning materials through open content, and also access other experts on a topic through their websites, social network profiles, and blogs. Learners can post media-rich assignments either individually or as a group; these assignments, after being assessed, can be loaded

Figure 4. Analysis of Web 2.0 tools from an educational perspective



by learners into their own personal learning environments for later use when seeking employment or transfer to graduate school.

The above example from Figure 4 assumes the context of a course being studied for academic credit, but the framework would also fit the non-institutional or informal approach to the use of Web 2.0 for learning, with a focus on tools such as Facebook, blogs, and YouTube. These applications would be much more learner driven, with the learner having complete choice and control over the tools and their uses.

WHO DECIDES?

In an institutional setting, who should decide on the form of e-learning (blended or fully online/distance), on the overall teaching approach (teacher or learner centered), and on the choice of technologies (an LMS and/or Web 2.0 tools)? Traditionally, and particularly in post-secondary education, it has been the individual instructor. However, increasingly, there are strong reasons to adopt a whole-program approach to decision making in this area.

This would mean all the teachers in a program, such as a Bachelor of Arts or a Master's in Business Administration, coming together to discuss not only the content of the program, but also how it should be delivered. The program team would develop an overall plan for the program, which would try to answer the following questions:

- What kind(s) of students (full-time, part-time, off-campus) are we trying to reach with this program?
- What is their experience in using technology for learning?
- How well will this program prepare our learners for knowledge-based work? What skills are we trying to develop in this program? What will distinguish an "A" student from the rest in this program?
- What kind of content do we want learners to access? Where is it? Do we have to create it from scratch, or does it already exist on the Web? Can learners find their own material? If so, what guidelines or criteria should we provide?
- What is our overall philosophy of teaching going to be in this program? How will our teaching approach support the skills we have identified as being important? Do the early courses have to start didactically, with a lot of supplied information? Do we have to de-

liberately help students become independent learners? How relevant are the learners' own life experiences likely to be for this program? How can we best draw on these?
- How can technology help us achieve our goals in this program? How will the use of technology change during the program? Which tools should we be using, and why?
- What support will we need in the use of technology, both for those teaching and for those learning? What prior training is required?

In making these decisions, it will help if the following points are borne in mind:

- E-learning is well suited for developing the skills needed in a knowledge-based society, in particular how to find, evaluate, organize, and apply information relevant to specific work areas. Using technology for learning prepares learners for knowledge-based work.
- E-learning is particularly suited for lifelong learners, those already in the workforce, who may already have at least a first degree, who have jobs and families, and/or who do not want to come on campus on a regular basis.
- Web 2.0 tools provide learners with powerful means to create their own learning materials and personal learning environments.
- Web 2.0 tools of themselves do not teach or result in effective or meaningful learning—there must be a particular purpose or rationale for their use, and teacher support and guidance in most cases are still likely to be essential. However, they may be provided in different ways from conventional teaching.
- There is tremendous scope for innovative uses of Web 2.0 tools, but this requires an institutional environment that encourages and rewards exploration and risk taking.
- Decisions about the use of e-learning are best taken in a whole-program context, rather than by individual teachers working in isolation.

CONCLUSION

ICTs, and in particular the new Web 2.0 tools, present a major challenge to all educational and training organizations. Web 2.0 represents not just a new generation of tools, but a significant shift in approaches to teaching and learning that challenge the very existence of formal educational institutions. At the same time, many of these new tools can be integrated within a more structured context, and provide significant educational benefits through empowering students to create and manage their own digital learning materials.

There is no sign that the pace of change in ICTs is slowing. If anything, the context is even more complex and challenging now than ever before. In such a volatile context, it is critical that educational organizations have processes in place that encourage dynamic change, innovative uses of technology, and monitoring and evaluation of what works and what does not. Above all, it is important not only to recognize the new opportunities that these tools offer, but also to make sure that they are used in educationally meaningful ways. Despite these cautions, used wisely, Web 2.0 tools can help bridge the gap between the requirements of academic rigor and the lifestyles of modern learners.

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