

Web 2.0 in Teacher Education: Two Imperatives for Action

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ABSTRACT. Web 2.0 represents a more participative and potentially paradigm-changing environment for building and sharing knowledge. Some educators have begun to apply these tools in classrooms but, as their use in society expands, there will be expectations for their wider application in schools. Teacher education faces the dual challenges of applying Web 2.0 tools to enhance teacher preparation and preparing teachers for whom the application of Web 2.0 tools in the classroom will be authentic practice. One path forward is to use Web 2.0 tools to develop learning communities for teacher preparation around e-portfolios in ways that encourage increased professional engagement by teachers while providing experiences that will support use of Web 2.0 tools in the classroom as authentic practice.

KEYWORDS. Web 2.0, teacher education, learner community

The World Wide Web (WWW) has changed. That much is clear. In the 15 years or so since it emerged from the laboratories at CERN (Berners-Lee, 1999), it has evolved from a method for sharing text and occasional images within the privileged academic environment to the everyday means for sharing text, images, audio, and video among people around the world. A recent report in Australia [Australian Bureau of Statistics (ABS), 2007] revealed that in 2006, 63% of dwellings had access to the Internet and 40% had broadband connections. There are significant variations by region and

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socioeconomic status but access, though not universal, is widespread and the rate has nearly doubled since the previous census in 2001. Similar, or in some cases more rapid, uptake of the Internet is occurring across the developed world.

Early adopters of the WWW in the world of academe will remember the consternation that greeted the first appearances of advertising on the Web. By now, for many of the same people, any business without a Web address is out of sight, out of mind, and potentially out of business. Information that, until a decade or so ago, might have been unearthed by hours of diligent library work is now available almost instantly from any computer with a connection to the Internet and a Web browser able to access Google. If something as new as the WWW can be said to have traditions, then these uses that treat the WWW as a means of providing and obtaining information are traditional. Their characteristic mode of operation is for one of a relatively few individuals or organizations to publish information on the Web, thus making it available to a large number of potential consumers.

In recent years, new, less traditional uses have emerged for the Web. Most of these are characterized by opportunities for the large number of those who would be consumers in the traditional model to contribute content to the Web. The forms of content that can be contributed directly into Web sites include text (blogs and wikis), images (Flickr and similar sites), audio (podcasts), and video (YouTube). In addition to these, there are services that allow users to participate in various group activities and to complete, individually or collaboratively, a variety of tasks such as document creation and editing that would previously have relied upon software on a local computer.

The changes in the WWW are manifest, but do they amount to the qualitative leap implied by the change in label from Web 1.0 to Web 2.0? Regardless of whether the changes associated with Web 2.0 really warrant the label, what are the implications for education and, more particularly, for teacher education?

WHAT IS WEB 2.0?

The concept of Web 2.0 emerged around 2004 and is generally attributed to O'Reilly. In O'Reilly's (2005) account of the concept, he noted that the boundary was blurred but identified the core as being the emergence of the Web as a platform supporting applications and services that operate on data controlled by users. More recent attempts at definition have continued to accept the blurriness while echoing the general concept articulated by O'Reilly:

Web 2.0 encompasses a variety of different meanings that include an increased emphasis on user generated content, data and content sharing and collaborative effort, together with the use of various kinds of social software, new ways of interacting with web-based applications, and the use of the web as a platform for generating, re-purposing and consuming content. (Franklin & van Harmelen, 2007, p. 4)

From the perspective of the user, the change from Web 1.0 to Web 2.0 is from an ecology with a few content authors and many readers to one in which users generate, re-purpose, and consume shared content (Franklin & van Harmelen, 2007). Where the Web, as experienced by most users until recent years, was effectively ‘read only’ except for minimal entry of data to drive search engines or electronic commerce, the experience of working with blogs, wikis, social bookmarking, syndication, and collaborative editing is qualitatively different. It is described by some as the ‘read/write’ Web to distinguish it from the ‘read only’ Web most often experienced in the past.

The WWW as originally conceived was a “read/write” environment in which the same software was to be used to both publish and access pages stored on a server (Berners-Lee, 1999). Somehow, in the early development of Web browsers for general use, this aspect was de-emphasized; and, although some browsers such as NetscapeTM included facilities for editing, most did not, or, if they did, those facilities were not widely used. In this respect, the first decade of what most people have experienced as the WWW was not entirely true to the original vision, and what is being described as Web 2.0 is not so much an extension of the WWW as a completion of that original vision. Nevertheless, it is clear that the WWW being experienced today is different from what has been widely experienced in the past and offers a variety of new opportunities for users. These opportunities are already beginning to affect social, business, and educational activities and there is every reason to expect those effects to continue.

As Web 2.0 develops, it will not be possible for educators at any level to ignore it. Society, especially employers, will expect education to develop essential skills with the new tools, and learners already familiar with the tools will expect to be able to apply their knowledge and skills while learning (Attwell, 2007). Teacher education has the dual challenge of applying Web 2.0 in ways that will enhance learning opportunities for teachers in preparation, while simultaneously preparing teachers to work effectively with Web 2.0 in their own classrooms. Hence, it is important for teacher educators to be aware of the educational potential of Web 2.0 and

to evolve their programs in ways that both take advantage of that potential to enhance the programs and prepare graduates who will be able to apply Web 2.0 in their own work.

WEB 2.0 IN EDUCATION

Although Web 2.0, with its emphasis on the WWW as a participative experience, is presented as a relatively new idea, educators have recognized the Internet as a place for participation since access became available in schools.

Lake (1995) characterized the Internet, at least for teachers and their classes, as being “a place to talk, a place to get organized information, a place to organize and put information” (p. 23). Of the three categories of use identified, only the second, “a place to get organized information,” can be understood as casting teachers and students primarily in the role of consumer. The others assume an element of contribution. Lake was writing not long after the WWW had begun to be available to schools, and, although he mentioned it as a source of information and a place to publish, his thinking was mostly about the wider range of services, including e-mail, available on the Internet rather than the WWW as a sole focus of activity.

Around the same time, Williams and McKeown (1996) wrote about how, in teacher professional development, they had “marginalized the ‘network of networks’ model and the ‘information model’ of the Net, replacing them with a communities model that places the teacher inside the Internet as an integral contributor to their profession” (p. 5). In the same study, they wrote about differences between adult and youth use of the Internet in terms of immigrants, natives, and tourists, anticipating the idea widely popularized by Prensky (2001). The oz-Teachernet (<http://www.oz-teachernet.edu.au/>) Project they described continues as a promoter of innovative and participative Internet projects for teaching and learning. Some of these continue to use e-mail and other ‘traditional’ Internet tools but others are using Web 2.0 tools such as wikis. Regardless of the tools used, the project has a strong focus on participation by users in a community frame rather than simple access to information.

Although the Internet as a venue for active participation by teachers and learners is not new with the advent of Web 2.0, what is new is the variety of tools, with as many as 1,600 being listed (<http://www.go2web20.net/>). Most are free to use, at least in their most basic form, and are available

from any computer with a Web browser and connection to the Internet. Because data may be stored on a server or on a portable device such as a USB flash drive, users can often work with their own data regardless of location, making computing effectively ubiquitous.

“Ubiquitous computing” was described by Weiser (1991), based on developments at Xerox PARC in which it was proposed that computers would become as common as electric motors and effectively invisible when a typical room might contain many networked devices with different functions. In this view, data, software, and processing power would be in the network and accessible anywhere using devices appropriate to a task. Instead of a personal computing device moving with a user, the user would move within a networked computing environment that provided multiple access points. Significant elements of this vision are being realized in Web 2.0.

Access to appropriate computer hardware and software is a prerequisite for the IT revolution to have any appreciable effect on education. For IT to generate the same degree of change in education as has happened in business would require similar levels of access to computers to enable the significant changes in traditional patterns of activity. Norris and Soloway (2006) identified Web 2.0 and mobile computing as disruptive technologies, capable of sparking a significant change in the way that education is conducted, and they argue for support of one-to-one computing programs to ensure access. Bull and Garofalo (2006) reviewed a 2002 statement about the challenges that education would face in an age of ubiquitous computing. They noted that there was high usage of computing outside of schools, with 87% of U.S. teenagers reportedly using the Internet in 2005 with high social interaction. Moreover, more than half were content creators, mostly via Web 2.0 applications. When the 2002 statement was written, the future of ubiquitous computing was imagined to be an extension of the graphing calculator toward a general-purpose handheld computer. In reality, handheld computers have converged with cell phones, and, at the same time, ubiquity has become less about portable devices than about carrying data on flash memory devices or being able to access data on the network for use with software provided through the network. Ensuring that access to the network is available to all will present challenges that, in many cases, will require provision of networked computers, but the requirements of those devices will be more modest when the real computational power is available on the network.

Over the past couple of decades, many educators have come to accept the idea of the Internet as a participative medium rather than a mere source of information and they have accepted that, for IT to make a difference in

education, each learner requires access to hardware and software capable of enabling new ways of dealing with information in many forms. Web 2.0 offers a variety of powerful and accessible tools that support participation and make it possible for users to acquire, process, and distribute information in a variety of digital formats. Web 2.0 tools are being adopted widely by individuals for personal use such as sharing of images on Flickr or video on YouTube and are being adopted by major corporations and political parties (Thompson, 2007).

Attwell (2007) hypothesized that “educational systems and institutions are developed to meet the needs of society” at some particular time and that “industrial revolutions lead to profound and often paradigmatic social change” (p. 1). He argued that the present industrial revolution around digital technologies is creating the pressure for paradigmatic change, from society, especially employers, requiring new knowledge and skills and from the ways in which Web 2.0 is beginning to affect how we deal with knowledge. The current model of schooling was based on the factories of a previous industrial revolution and is not suited to the newer requirements for lifelong learning, the changing approaches to developing knowledge, or the different cultural approaches to learning among the young. Attwell (2007) suggested that the most significant driver for change to our education system may be the changing ways learners are using computers. Navigating vast amounts of information requires different skills than were needed when the challenge was to locate scarce information rather than apply judgment to select from abundance. Young people especially expect to be able to remix and share material often by way of social networking sites that provide tools and access to other users. Activities in these spaces are increasingly important to development of identity, but the effect of these developments on learning is uncertain. There is evidence of informal learning through social networks, but young student teachers who have grown up in the milieu frequently see little or no connection between their personal and their professional use of the read/write Web.

In assessing the responses of education systems to the challenge of Web 2.0, Attwell (2007) concluded that primary (elementary) education, because of its common use of story telling, group work, and project-based learning, is able to adopt Web 2.0 tools reasonably well. However, he identified secondary education, at least in Europe, as problematic. Despite repeated efforts at reform, there continue to be problems with engaging a significant proportion of teenagers, teachers are disillusioned, and employers complain about low levels of skills. In his view, three aspects of dysfunction are evident in secondary schools. The first is the use of

educational technologies in ways that limit the potential by replicating traditional forms of organization rather than adopting the networking and creativity that learners are likely to experience outside of formal education. The second is the persistence with a rigid focus on developing and assessing individual attainment in a world where networked activity is increasingly important. The third is assessing learning only against a narrow curriculum despite the variety of networked informal learning in which young people are engaged. Attwell's prescription for reform was to end the isolation of school from wider forms of community and knowledge sharing through such means as community learning centers, project-based learning, open educational resources, personal learning environments, mixed age learning, and assessment *for* learning as a tool for enhancing learning rather than assessment *of* learning as a final measure of outcomes. Many, if not most, of these reforms would benefit from the application of Web 2.0 tools and would equip learners to make more effective use of such tools.

Web 2.0 presents both challenges and opportunities for education. As noted above, for teacher education there is a twofold imperative, to prepare teachers to use Web 2.0 in their own classrooms and to take advantage of what it has to offer for immediate application in teacher education programs. Having considered some of the general implications of Web 2.0 for education, it is useful to review some examples of current applications in schools and higher education as background to considering how Web 2.0 might be approached in teacher education.

WEB 2.0 IN SCHOOL EDUCATION

As has been the case with office productivity applications, teachers and schools have applied the standard Web 2.0 tools in support of learning activities. Those experiences have been shared across teacher networks, often using Web 2.0 tools such as blogs and wikis, and in teacher publications. The International Society for Technology in Education (ISTE) journal, *Learning & Leading with Technology*, has carried numerous articles on Web 2.0 topics as have publications of other teacher associations. Institutions such as *Futurelab* in the UK have produced reports (Grant, 2006; Owen, Grant, Sayers, & Facer, 2006) about the potential of Web 2.0 tools for schools, including case studies of applications, but the movement is still new enough that there has been too little time for much substantial research to appear. Nevertheless there are indications of emerging work providing frameworks for research from perspectives such as literacy (Lankshear & Knobel, 2006) and communications theory (Schmidt, 2007), and it seems

likely that research based on these and other frameworks will appear in the near future.

The networked participation characteristic of Web 2.0 allows practitioners working with the tools to share their ideas and experiences. Acknowledged leaders have emerged with strong reputations based on the content of their blogs and validation of their experience by others. Will Richardson's blog (<http://www.weblogg-ed.com/>) has provided one focal point for activity, and his experience has been documented in a book that provides a theoretical and practical guide for teachers seeking to use Web 2.0 tools (Richardson, 2006).

Richardson (2006) referred to the read/write Web rather than to Web 2.0 and noted that the original concept of the Web included writing as well as reading. He identified seven technologies that comprise the toolbox of the read/write Web—weblogs, wikis, RSS, aggregators, social bookmarking, online photo galleries, and audio/video-casting. He described each in detail, with examples of educational applications, and he also addressed issues such as keeping students safe and dealing appropriately with intellectual property. "The classroom of the Read/Write Web is one of seamless transfer of information; of collaborative, individualised learning; and of active participation by all members of the class" (Richardson, 2006, p. 127). In his view, the technologies are driving 10 major shifts in education, which he described as open content, multiple teachers and 24/7 learning, social and collaborative construction of knowledge, conversation rather than lecture, know "where" learning, more active readers, Web as notebook, writing beyond simple text, working toward mastery rather than the test, and striving for contribution rather than completion. These trends echo the directions suggested by Attwell (2007), and, if even some of them eventuate to a significant extent, they portend significant changes in school education.

Although teachers are using standard Web 2.0 tools in their classrooms, there are opportunities for adapting such tools to make them more suitable for education or creating new tools specifically for educational use. One motivation for such developments will be to provide environments that mitigate some of the risks associated with having students engage in activities on the open Web, but it may be equally useful to adapt tools to provide specific support for educational activities or to create new tools, or mashups (combinations of existing tools), for specific tasks. One example of the latter is an online image analysis tool designed for use in science education within the context of an environment that supports collaborative development of science research papers by teachers and students (Raeside, Busschots, Waddington, & Keating, 2008).

WEB 2.0 IN HIGHER EDUCATION

Opportunities and challenges associated with Web 2.0 for higher education are similar to those described for school education, but access to the Internet is typically more pervasive, and working with older learners involves higher expectations for the work done using Web 2.0 tools and allows greater freedom for students. The research culture of higher education also means that it is more likely than in the school sector that published material will go beyond mere description to provide evidence for claims. Articles promoting the use of blogging in higher education (Downes, 2004) and reporting the results of early research (Dickey, 2004; Williams & Jacobs, 2004) were already appearing as the concept of Web 2.0 began to emerge (O'Reilly, 2005).

More recently, Web 2.0 has been examined for its potential as a “new wave of innovation for teaching and learning” (Alexander, 2006, p. 33). According to Alexander, the key concepts associated with Web 2.0 in education include *social software*, which he viewed as emergent new practice rather than sharp discontinuity with the past; *microcontent*, the trend toward identifiable chunks of content less than a page, thereby allowing repurposing and recombination in “mashups”; ease of access through *openness*; and tagging by users to create *folksonomies* rather than a single authoritative taxonomy of content. These concepts find expression in new processes and practices such as *social bookmarking*, which supports pedagogy through collaborative information discovery; *social writing platforms* that support student group learning and staff collaborations; and *blogging*, which is the “signature item of social software” (Alexander, 2006, p. 38) and provides access to current information in a field. Among the risks identified by Alexander as attaching to Web 2.0 are the fluid and emergent nature of the medium that results in disappearance of content through movement or deletion and the ease with which copyright can be violated. Educators using Web 2.0 need to attend to these issues.

Franklin and van Harmelen (2007) rehearsed a similar list of tools and concepts under the rubric of social software: blogs, wikis, social bookmarking, media sharing, social networking, and social presence systems, collaborative editing tools, syndication, and notification technologies. They also noted the possibilities of bricolage and mashups in which users can bring together data and tools from separate sources to meet their own needs. Their report includes examples of educational uses and discusses the lessons that have been learned and issues to be considered. Although problems at the sites they investigated were few, to be successfully

implemented, Web 2.0 tools require promotion and support. Tools need to be selected, but the rapid rate of development means that tools that prove unsuitable are usually quickly updated or supplanted.

It is tempting to assume that the application of Web 2.0 tools in higher education will be facilitated by the generation of students now entering higher education from schools already familiar with a variety of Web 2.0 tools. Nevertheless, given the abundance of Web 2.0 tools and the rapid development cycle, it is not surprising that their experience is somewhat selective. A recent study involving computer science students in Austria found that blogs and media sharing (YouTube) were well-known and that wikis and blogs were the most used among the tools investigated. Other tools, such as social networking and social bookmarking, were less well-known and less frequently used (Safran, Helic, & Gütl, 2007). Selwyn (2007) reviewed Web 2.0 applications for informal learning, focusing on Facebook and Second Life. He found that Facebook is very informal and plays a role similar to the out-of-class interactions that occur on campus, that Second Life has similar characteristics, and that the potential of such tools is tempered by limited penetration. There are issues of safety related to examples of inappropriate behavior and questions associated with the care that should be taken when sharing information in such venues. He also raised the possibility of resistance or resentment arising if young people sense that their cultural forms are being appropriated without consent.

Despite the challenges identified in these studies, there are a growing number of accounts of Web 2.0 application in higher education reporting cautious claims for success. In one study in which students created educational podcasts for their peers (Lee, McLoughlin, & Chan, 2008), students found the task challenging and motivating, and there was evidence that the activity had potential for enhancing learning through articulation of ideas and concepts. However, the authors found that there was a need to provide more support to students in order to maintain a focus on the cognitive aspects of the task rather than the technology. Until Web 2.0 tools mature and users gain sufficient experience to become fluent in their use, this need for support to avoid learning being overwhelmed by technological issues seems likely to be a common issue.

WEB 2.0 IN TEACHER EDUCATION

In common with other areas of higher education, teacher education has begun to consider the implications of Web 2.0. As noted above, teacher

education will need to approach Web 2.0 on two fronts, application to enhance learning in the process of teacher preparation or professional development and application to classrooms where teachers will be expected to use Web 2.0 tools with learners.

Greenhow (2007) highlighted participation as the key feature of Web 2.0 and pointed to its potential to “facilitate increased interaction and networking between teachers, students and others and the co-creation of content” (p. 1990) in ways that advantage a constructionist approach to teaching and learning with Web-based social networks, thus allowing access for teachers and students to sources of feedback for improvement. The significance of participation through online communities is apparent in the published studies of Web 2.0 in teacher education.

Teachers Learning With Web 2.0

Privatization of teacher practice has been a recurrent theme in the literature, and the benefits of professional engagement have been observed (Becker & Riel, 2000; Riel & Becker, 2000). The factory-like conditions of schooling (Attwell, 2007) tend to separate teachers from their peers, with limited opportunities for professional exchanges during a typical school day. Online communities for teachers have been established using a variety of technologies and with varying degrees of success (Schlager & Fusco, 2003). Web 2.0 tools have potential for developing and sustaining teacher professional communities, but it is necessary to ensure that the focus is on the theory and practice of teaching rather than the technology (Wubbels, 2007).

Evans and Powell (2007) discussed the potential for building a community of practice in teacher education around e-portfolios. They proceeded from the proposition that privatization of practice commences during teacher preparation and that Web 2.0 tools may be used to encourage knowledge generation and social interaction among teachers in preparation. “Though skeptical of the current possibilities for designing communities of practice, [they] see value in changing focus to the support and sustainability of existing communities with online interactions and digital artifacts” (p. 201). They recommended the use of Web 2.0 tools to promote communities of practice around the development of e-portfolios.

A study of beginning teachers’ use of online resources and communities found that most use was at a superficial level, mainly location of resources using online search engines (Moore & Chae, 2007). Few of the beginning teachers progressed beyond finding ideas for classes. They

had little apparent use for communications beyond e-mail with existing contacts or listservs, and they had limited interaction with online communities. Although they typically did not seek emotional or personal support from online communities, they found stories of other teachers' experiences helpful. Moore and Chae (2007) anticipated increased propensity to use online communities in coming years as younger teachers with different prior experiences of the Internet graduate. However, if privatization of teacher practice begins during preparation (Evans & Powell, 2007), graduating teachers who are more likely to engage productively with online communities will require more than simply waiting for a new generation of teachers to emerge.

Studies of teachers using blogs have reported positive results. Ray and Hocutt (2006) studied 16 teacher bloggers using open-ended interviews, electronic dialogue, and content analysis of the blogs. They found that blogs promoted reflective practice as well as collaboration and social interaction among users. The latter included sharing ideas, addressing matters of professional concern, overcoming isolation, and dealing with frustration. Among the key issues considered were matters of ethics, especially privacy. Fifteen of the 16 participants in the study chose to mitigate risks to schools, students, and personal reputation by blogging anonymously. Another study used blogs as a voluntary means to support an online learning community involving 15 beginning teachers, 11 mentor teachers, and 9 college faculty (Loving, Schroeder, Kang, Shimek, & Herbert, 2007). The reaction to using blogs was mixed, with many participants experiencing barriers to use such as lack of time and familiarity with blogs. Most activity comprised individual posts rather than sequences involving comment on posts by others. The researchers concluded that the activity required more introduction to familiarize participants with the tools and processes, that faculty support was a benefit although there was need to be cautious about dominating conversations, and that face-to-face meetings and blogging were complementary.

Beyond application of standard Web 2.0 tools to support teachers, as described in the preceding paragraphs, there exist possibilities for development of tools specifically designed for teachers. An example of such a tool is PBL-Online (<http://www.pbl-online.org/>), a resource to support teachers in applying project-based learning in their classes (Schmidt, Mergendoller, & Rice, 2007). In addition to a Web 1.0 style site presenting content provided by the publishers, the site includes a PBL-CoLaboratory where teachers working with project-based learning can share their own curriculum plans, search for and download materials for use, and, when

the site is in full operation, enter reviews of projects provided by others. To date, there are 34 projects in the site, and it remains to be seen how successful it becomes as a focus for teacher sharing. Depending on its success, the potential for similar sites supporting other aspects of teacher learning is evident.

Teachers Learning About Web 2.0

Skilled teachers draw upon their own experience of the real world as a basis for authentic activities that support learning through participation. Where teachers have little or no experience of specific practices in the real world, they face particular challenges in designing authentic activities for classroom learning (Lankshear, Snyder, & Green, 2000). New social practices such as those associated with Web 2.0 are obvious sources of such challenges, and teacher preparation needs to provide experiences that will enable teachers to develop authentic activities for use in their own classrooms. Engaging teachers in appropriate activities that require them to use Web 2.0 for their own learning will make a significant contribution in this regard. Hence, the best approach to helping teachers learn *about* Web 2.0 may well be to have them learn *with* Web 2.0.

In one example of this approach, a graduate-level technology integration course was redesigned to use Web 2.0 tools (Oliver, 2007). Students were required to complete activities in which they blogged, collaborated on documents using Google Docs and Spreadsheets (<http://docs.google.com/>), prepared a multimedia presentation using their choice of a Web 2.0 tool, used Trailfire (<http://trailfire.com/>) to create a teaching resource, engaged in social bookmarking using del.icio.us (<http://del.icio.us/>), and created a collaborative concept map using CMap Tools (<http://cmap.ihmc.us/>). All of these activities are capable of direct application in the classroom, and using them in this fashion provided students in the course with authentic experience of how the tools could support learning and the challenges that might be experienced by first-time users. Students responded well to the use of Web 2.0 tools, although there were mixed reactions to the use of blogs, which had the least obvious direct application to the classroom. Oliver noted that because Web 2.0 tools often require creation of a login and leave an information trail that is publicly accessible, consideration needs to be given to privacy, ethical standards of behavior, and the steps necessary to gain access to various tools. Instructors and students also need to be aware that the tools are evolving and may change or disappear

between one use and the next attempt. Students will benefit from being aware of these considerations as part of the authentic practice of Web 2.0.

Another example describes a teacher preparation course that included use of a social bookmarking tool as part of an educational Web site evaluation assignment and integration of Web 2.0 tools into a lesson plan (Voithofer, 2007). Data collected at the commencement of the course established that the majority of the students had little or no prior experience of Web 2.0 social networking sites such as MySpace and Facebook. Of the two groups of students participating in the activities, the middle childhood group that was concurrently engaged in student teaching found it easier to develop appropriate lesson plans using Web 2.0 concepts than the secondary group that had not yet started student teaching placements. This is a further indicator of the importance of authentic experience as a basis for teachers' planning (Lankshear et al., 2000). In addition to the perennial issues associated with appropriate treatment of intellectual property on the Web, Voithofer (2007) identified three significant challenges that warrant consideration by teacher educators working with Web 2.0 tools. The first is the continuing viability of teacher education or other programs as collections of discrete, unconnected courses when students are "engaged in a highly hyperlinked environment in which digital content is collaboratively generated, commented on, categorized, linked to and from, and modified" (p. 16). The second is the implicit challenge for teacher educators to engage with Web 2.0 in ways that enable them to create authentic learning activities for teacher preparation as a precondition for graduates being able to do so in their classrooms. The third is the need to prepare teachers to deal with the ways in which the Web 2.0 technologies include or exclude particular people and ways of knowing.

A WAY FORWARD?

The World Wide Web has changed, and it is likely that as a consequence of the new tools for collaboratively building and sharing knowledge, society and its important institutions, including education, will also change. If the changes in society arising from the current industrial revolution (Attwell, 2007) are sufficient to cause a significant misalignment with the educational institution "fundamental educational change" (Waks, 2007, P. 277) may result. When, or if, that happens, organizational changes in schools and the curriculum will follow and teachers will need to adapt.

Even if such “fundamental educational change” is a long time coming or does not come at all, schools and teachers cannot ignore Web 2.0, with the opportunities and challenges it brings. Neither then can teacher education. The challenge is how to accomplish the necessary changes in teacher education to respond to the dual imperatives of using Web 2.0 tools to enhance teacher education and prepare teachers who can apply the tools in their classrooms. As noted previously, the best way for teachers to learn *about* Web 2.0 may be through learning *with* Web 2.0 as authentic practice that can inform their planning and implementation of learning activities.

Based on the limited research to date, there is reason to believe that Web 2.0 tools can contribute to reducing privatization of teacher practice and increasing professional engagement by supporting online communities for teachers. Because there is evidence that privatization of teacher practice begins during teacher preparation (Evans & Powell, 2007) and that students in higher education have limited prior exposure to more than the most common Web 2.0 tools (Safran et al., 2007; Voithofer, 2007), it is important that the use of Web 2.0 tools in ways that limit the tendency toward privatization of practice be introduced early in teacher education programs in order to allow maximum time for development of patterns of authentic practice prior to graduation.

Building and supporting a learning community around e-portfolios has been suggested as a strategy for sustainable communities of practice in teacher education (Evans & Powell, 2007). A *learning landscape* model has been advocated (Tosh, Werdmuller, Chen, & Haywood, 2006) as a way of enabling students to see learning as going beyond the narrow confines of courses and programs to incorporate experience from a variety of contexts through social networking. “Learning with computers is not about programming or drill and practice, nor about multimedia, nor about fast updating or cost-efficiency—it is all about humans sharing ideas” (Tosh et al., 2006, p. 7). The conceptual framework of the learning landscape works with e-portfolios as a focus for learners using Web 2.0 tools to link components in ways that maximize the usefulness for life-wide learning by placing ownership of the e-portfolio with the user rather than an institution. Working with e-portfolios in the context of an online learning community would provide benefits similar to those of the *atelier* or studio mode proposed by Brown (2006) as a powerful social learning environment that makes efficient use of instructor time and should encourage habits of mind that mitigate against privatization of practice.

Development of learner communities around e-portfolios using Web 2.0 tools appears to offer a way forward to increase professional engagement

of teachers while building the authentic experience required to support use of Web 2.0 in their practice. The challenge facing teacher educators who choose this path will be to engage with the Web 2.0 tools in ways that make this authentic practice for them.

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