



Emerging Technologies

in Adult Literacy and Language Education

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Executive Summary

Although information and communication technologies have become an integral part of life in the United States, they have not yet been adequately integrated into adult language and literacy programs. This raises concerns because of the potential value of technology for enhancing learning and because of the vital role of technological proficiency as a gatekeeper for occupational success and full civic participation. Research findings on the impact of technology in education are mixed, but a few studies among adult learners suggest benefits worth exploring.

This paper describes the potential contribution of emerging technologies to adult literacy and language education and the opportunities and challenges involved in incorporating these technologies into adult education programs. Various emerging technologies (those arising or undergoing fundamental transformation in the last decade) are described, ranging from audio and video production to games, wikis and blogs, to mobile devices, cell phones and open-source software. Relevant research is reviewed, and the costs, difficulties and advantages of deploying various technological approaches in adult education are discussed. Although current research is insufficient to urge wholesale adoption of the technologies described, many—especially low-cost mobile devices—warrant further investigation as potentially valuable tools for adult educators and learners.

Introduction

Over the past decade, digital technologies have gone from being an optional tool for the few to a required tool for the majority. Fully 74 percent of people in the United States use the Internet at home or work today, including 87 percent of those ages 18–29, compared with fewer than one-third of Americans 10 years ago (National Telecommunications and Information Administration, 1999; Pew Internet & American Life Project, 2009b). Computers and the Internet are more important than ever before in domains ranging from employment to education to civil affairs (Bureau of Labor Statistics, 2009; Pew Internet & American Life Project, 2009a).

At the same time, the form and function of computers and the Internet have changed dramatically. A decade ago, a typical person went online at a desktop computer using a slow, sometimes-on Internet connection. Web content was created by a small minority. Today, the majority of computers sold are laptops, most of which access the Internet from always-on broadband wireless connections. Millions more locate online information through personal digital assistants or telephones. Tens of millions of people contribute to Web content through blogs, wikis, podcasts and other “Web 2.0” technologies, and people and information connect through vast social network sites. As a result of this expansion, many employers are looking for much more than basic computer skills; they seek the kinds of autonomy and creativity with technology that comes from extensive self-directed use.

This paper analyzes this new technological landscape and its significance for adult literacy and language education. In carrying out this analysis, we recognize that some of the best uses of computers and the Internet for adult language and literacy instruction include tried-and-true applications and activities from the 1990s—such as using Web browsers to search for information about careers and communities—or even from the 1980s—such as using word processing programs to write and edit resumes. Rather than duplicating prior efforts to document these kinds of technology uses, we instead hope to spark ideas among policy leaders about the possible role of emerging technologies (i.e., those either arising or undergoing fundamental transformation in the past decade) in adult literacy and education.

We believe that these emerging technologies can help diverse adult learners to develop both the language and literacy skills and the proficiency with new media required to fully participate in a rapidly evolving information society. We first review the needs of adult literacy and language students in relation to technology access and use, and we then analyze emerging technologies for adult literacy and language education and professional development.

Technology and the Needs of Adult Literacy and Language Learners

Students in adult literacy and language programs come from a wide variety of backgrounds, but, compared to the nation as a whole, they are disproportionately black or Hispanic, have low incomes and limited education, and are not native English speakers. These are precisely the groups least likely to have home access to computers and the Internet. (See detailed review in Warschauer & Matuchniak, 2010.) According to the most recent national data, only 26.8 percent of households with a family income under \$15,000 have Internet access, compared with 91.4 percent of households with income over \$75,000 (National Telecommunication and Information Administration, 2008). Only 24.4 percent of households headed by someone without a high school diploma have Internet access at home, compared with 84.1 percent of households headed by someone with at least a bachelor's degree. Only 44.9 percent of blacks and 43.4 percent of Hispanics have Internet access at home, compared with 67.0 percent of whites. And within each ethnic or socioeconomic group, those with limited literacy and English-language ability have much lower levels of Internet access (Fairlie, 2007; Strawn, 2008), leading one researcher to conclude that the technology gap between English-speaking whites and non-English-speaking Hispanics is "on par with the Digital Divide between the United States and many developing countries" (Fairlie, 2007, p. 287).

Yet these same groups desperately need access to technology and the skills required to use it. Well-paid jobs involving manual labor are disappearing, and even entry-level jobs increasingly require technology skills (Bureau of Labor Statistics, 2009). Information from employers, government bureaus, social service organizations and community groups is increasingly found online, and opportunities for further information and support are also available through online communication and networking. Parents need to understand and use computers and the Internet to monitor and guide their children's online activities, and immigrants benefit from online communication with relatives and friends in their home countries. In short, we are becoming both a knowledge economy and an information society, and those who cannot access and use

information and communication technologies face marginalization (Warschauer, 2003).

Fortunately, the diffusion of digital technologies represents not just a challenge but also an opportunity for adult literacy and language learners. New technologies can help expand adults' learning opportunities (Stites, 2004), and the development of technological skills can enhance adult learners' occupational prospects. Many adult learners are strongly motivated to learn computer skills for both employment opportunities and fuller participation in society. The costs of computers and Internet access have dropped substantially in recent years, making access to technology much more affordable. And while advanced English-language and literacy proficiency is helpful for making sophisticated use of new technologies, research suggests that even adults with very low literacy or language proficiency can benefit from online access. (See review in Silver-Pacuilla & Reder, 2008.)

Changes within the adult learning population are also noteworthy. A growing number of teenagers and young adults are participating in adult education: 41 percent of adult education students are now younger than 25 years of age and 16 percent are younger than 19 (Welch & Di Tommaso, 2004). Adult education programs often do not meet the needs or reflect the learning styles of younger learners, resulting in a high dropout rate among this group (Weber, 2004). Younger learners want to use technology in their adult education classes (Garner, 2004), and they expect other types of learning experiences that can be facilitated by technology use, such as networking with peers, obtaining popular culture materials and producing student-centered content (Geary, 2004; Imel, 2003; Weber, 2004).

Finally, it is important to recognize the very diverse needs of learners in adult literacy and language education. Some will be mainly interested in developing reading and writing skills, while others will be focused on oral language development. Learners have a combination of functional, vocational and/or academic purposes for study, and they enter programs at beginning, intermediate or advanced levels, with varied proficiencies in different skill areas (e.g., fluent speaking combined with limited writing ability). New technologies discussed in this paper represent autonomous learning tools that can be placed in the hands

of each individual learner, thus offering excellent ways to meet the needs of diverse students (Warschauer, 2006).

Emerging Technologies for Adult Literacy and Language Education

Technologies in five areas appear especially promising for meeting adult learners' needs: (1) multimodal communication, (2) collaborative writing, (3) language analysis and structure, (4) online networking and (5) one-to-one and mobile computing. We first examine the potential of using emerging technologies in each of these five areas in adult literacy and adult English as a Second Language (ESL) programs in the United States and then briefly consider their application in professional development for adult educators. Wherever possible, we will base our discussion on prior research; however, in many cases, published research on use of these new technologies with adult learners in the United States does not exist. Through this discussion, therefore, we also refer to research undertaken with other audiences, such as K–12 students, adults in higher education or learners in other countries. Further investigation will be necessary to determine if the findings are applicable for adult education in the United States.

Multimodal Communication

Multimodality involves combinations of linguistic, visual, audio, gestural and spatial modes of meaning (Kress & van Leeuwen, 2001). Multimodality has been incorporated in language and literacy education for youth and adults for some 20 years. It is considered an emerging technology, though, because of the new types of applications and sites — from podcasting to YouTube — that make it feasible for large numbers of learners without specialized training to produce and share their work.

Several reasons have been suggested for including multimodality in language and literacy education. These include familiarizing students with the types of meaning-making now gaining ascendancy in business and other environments, increasing student motivation by operating in multimedia realms familiar to them, helping students develop a critical approach to media (through producing it themselves), empowering students to create products culturally and socially relevant to their lives (by incorporating

multimedia images and sounds related to their lives and communities) and providing multimodal scaffolding for content production among students still developing their language and literacy skills. (See, for example, Cummins, 2008; Kress, 2003; New London Group, 1996; Warschauer, 1999.)

We divide our discussion of this issue into audio and audiovisual applications.

Audio Applications

The development and diffusion of software for producing, uploading, downloading and playing digital audio files (i.e., podcasts) make the flexible use of a wide range of audio material easier than ever in the classroom. The greatest potential use of this is in English-language learning programs.

Hegelheimer and O'Bryan (2009) conducted a review of podcast resources and technologies for second-language education. One resource they point to is ESLpod.com, which includes more than 500 free downloadable audio files organized by topic and developed especially for English-language learners. Other premade podcasts are available to promote academic listening skills, facilitate preparation for listening tests, provide grammar tips or cover business English topics (Hegelheimer & O'Bryan, 2009; Viswanathan, 2009). As O'Bryan and Hegelheimer (2007) point out, beyond providing listening material for in-class use, podcasts can be a repository of classroom discussions or lectures for use outside of class to extend and amplify what was covered in class and prepare learners for upcoming classes.

An example of podcast use in adult education is provided by Ramírez and Thomsen (2008), who document a program titled "Teaching English and Careers in Hospitality, The Hotel TEACH Project." Developed by the Center for Immigrant Education and Training at LaGuardia Community College in New York City, the program used a Blackboard site and podcasts to help adult immigrants develop the language skills expected of workers in the lodging industry. All students in the program were provided MP3 players to "extend the class" beyond normal instructional hours, "address varying skill levels," and "individualize lessons" for students who worked in different hotel areas (p. 58). Podcast lessons

included pronunciation or listening exercises geared to the particular needs of students, such as lessons on wines and spirits designed for a student who worked as a banquet server. A formal evaluation indicated that students in the program made substantial gains in both English and computer skills, resulting in many cases in increased career opportunities (Ramírez & Thomsen, 2008).

Audio podcasts also offer learners the opportunity to record their own speech in multiple genres (reports, simulated broadcasts, oral presentations, etc.) to share with classmates or others (Lu, 2009) or to review themselves later to reflect on their language-learning progress (Warschauer, 2006). Some educators report that students pay especially close attention to detailed aspects of their speech when recording such podcasts. (See Stanley, 2006, cited in O'Bryan & Hegelheimer, 2007.) Though student-created audio podcasts are more common in ESL instruction, they have potential value in general literacy instruction as well, as students can write scripts and then record them.

Educators also have students create musical compositions using software such as Garage Band (for the Macintosh) or Audacity (a free, open-source program for multiple platforms). In literacy instruction, uses include recording music to express the meaning of poetry, thus engaging students in active interpretation of what they read (Warschauer, 2006).

Another potential use of audio in the language classroom is cross-class exchanges. Such exchanges, involving students in one class communicating with other students across town or across the globe, traditionally have been written (e.g., e-mail), but recently educators have been experimenting with audio-based exchanges using Skype, Google Talk or other peer-to-peer voice-over-Internet-protocol tools. (See, for example, Mullen, Appel, & Shanklin, 2009.) A comparative study by Japson (2005) found some advantages for audio-based versus text-based computer-mediated communication, with students using audio mode more likely to negotiate for meaning and make conversational repairs. ESL instructors using such exchanges may want to experiment with incorporating audio to complement written text.

These applications of audio production and use have not yet been systematically studied in language and

literacy education, either generally or specifically for adult education. These uses do correspond to prior second language-learning theory and research regarding learner autonomy (see, for example, Benson, 2007), content production and audio input, and thus there is reason for some confidence in their potential value.

Audiovisual Applications

A wide variety of reasons has been offered for using student production of audiovisual material in language and literacy education for youth and adults, including developing media awareness, mastering new genres and producing documentation for student reflection (Warschauer, 2006). There are many audiovisual genres, from film to Web sites.

In a discussion of the Border Civics Project carried out with adult ESL students in Texas, Wrigley (2004) provides an interesting account of multimedia production in adult education and its relationship to relevant theory and prior research in adult education. Drawing on theories of adult learning, collaborative learning and multimedia in education, the two-year project provided training and resources to help teachers implement student-centered media production on civics topics in their classrooms. Students created CD-ROMs, videos, and Web-based projects on issues important to their community, including community maps, newscasts, literacy instructional materials and question-and-answer materials on domestic violence prevention. Teachers reported that their students were highly motivated in creating projects and that the skills they acquired were carried over to new settings at home, at work and in the community.

The digital story is one genre that has been promoted in language and literacy instruction. Storytelling has been a major means of transmitting culture and values throughout human history, perhaps because, as posited by cognitive scientist Schank (1995), humans are wired to understand knowledge communicated in story form. Digital storytelling involves incorporating digitized photos, video, audio, typography and texts into personal narratives.

More research has been conducted on digital storytelling with youth than with adults. Hull and colleagues have investigated digital storytelling among adolescents facing literacy challenges at a community technology center in

an impoverished community of Oakland, Calif. (Hull & Katz, 2006; Hull & Nelson, 2005). She suggests that students find such production highly motivating because it allows them to explore and express their sense of agency and to develop semiotic awareness as they experiment with meaning-making across modalities and media. The work of Hull and colleagues is supported by that of Cummins, who emphasizes the value of what he calls “identity texts” (Brown, Cummins, & Sayers, 2007; Cummins, 2008). These multimodal creations by immigrant youth bring together diverse digital resources that express values important to them, their families and their community. In a study among adult English-language learners, Nelson (2006) found that using multiple media in digital storytelling helps such learners amplify their sense of authorship, as they find deeper meaning in what they want to say through the process of combining modes.

An adult (noncredit) ESL class in digital storytelling is offered at MiraCosta College in California. According to the instructor, students take her class both to boost their computer skills and practice language in a meaningful context. The instructor has students combine photos they have taken with their own oral narrative, based on a written script they have produced. The exercise gives students a chance to practice grammar, pronunciation and oral delivery in a highly motivating context as they share life stories. At the end of class, students burn DVDs to share with their families, and some post their digital stories on YouTube. (See student productions at <http://mccdigital-story.blogspot.com/>.)

Sharing students’ multimodal work within a class, across classes or with a broader audience can help make multimodal production more motivating and interesting to students. In addition to YouTube, some other Web 2.0 sites useful in this process include VoiceThread (<http://voicethread.com/>), which allows people to post presentations with images, documents and videos and to comment using voice, text, audio file or video; Glogster, (see <http://glogster.com/edu> for the special educators’ site), which allows the creation of public or private “glogs” mixing graphics, photos, videos, music and text; and Authorstream (<http://authorstream.com>), which allows students to create flash versions of PowerPoint

presentations that they can host at that site or incorporate into their own blogs.

In summary, there is no doubt that multimedia technology is a powerful way for students from diverse cultures to convey heartfelt meaning. Because production often involves the audio recording of scripts the students write, it also can be used to reinforce writing and language development. Language and literacy instructors need to maintain an appropriate balance, so multimodality reinforces language and literacy goals rather than becoming a distraction, a problem sometimes noted by educators. (See, for example, Microsoft PiL National Evaluation Team, 2007.) Instructors’ guidance in helping students understand the significance, meaning and relevance of using graphics, audio and videos is crucial if students are to keep an appropriate balance between multimedia and texts (Petrie, 2003).

Collaborative Writing

The development of a knowledge economy has greatly amplified the value of being able to write well. A recent national survey of U.S. employers found that good writing is considered a threshold skill for salaried employment and that the majority of companies frequently or always include writing assessment in hiring salaried employees (National Commission on Writing, 2004). The study also found that, in fast-growing sectors of the economy, between one-fifth and one-third of hourly employees also have writing responsibilities, and bad writing (for example, on a resume or job application) can harm employment prospects. Knowing how to write well in discussion forums, blogs and other online sites is also valuable for civic participation, life skills and social relationships.

The ability to facilitate collaborative written communication has long been considered a major advantage of the Internet for both second-language learning (see, for example, Kern & Warschauer, 2000) and adult literacy (see, for example, Gillespie, 2001). Today, resources for collaborative online writing that were not available a decade ago include blogs, wikis and other free online writing tools.

Blogs

A blog (the term originally was a short version of “Web log”) is an online diary posted in reverse chronological order. (For an overview of blogging, see Gurak, Antonijevic, Johnson, Ratliff, & Reyman, 2004.) Previously, such online diaries could be constructed by laborious editing and republishing of Web pages, but specialized software popularized in 1999 made the process remarkably simple. (For an early history, see Blood, 2000.) By early 2006, approximately 39 percent of teenage and adult Internet users in the United States were reading blogs (Lenhart & Fox, 2006). **By August 2008, the blogging search engine Technorati was tracking 113 million blogs around the world, collectively known as “the blogosphere” (Technorati, 2008).**

Standard blog software today allows for posting images as well as text, links to other material within or outside the blog, and responses to blog entries by others (called “comments”). Most blogs fall into one of three general types: (1) personal journals documenting people’s personal thoughts, feelings and day-to-day experiences for themselves and others; (2) informational blogs seeking to further understanding of particular topics (e.g., business, technology) through brief postings and links; and (3) agitational blogs that seek to argue or persuade, often focused on political topics (Warschauer & Grimes, 2007). Blog structures vary, from single-author blogs with few links to external sites, few if any comments and infrequent updates, to complex multiauthor blogs with extensive linking and tagging, constant updates and voluminous commenting (Herring, Scheidt, Bonus, & Wright, 2005).

Examining the overall blogosphere, Herring and colleagues suggest that blogs fill an intermediary role within online genres, about midway between standard HTML documents such as personal home pages, and asynchronous computer-mediated communication (CMC) such as newsgroups, bulletin boards or e-mail discussion lists (Herring et al., 2005). Blogs are more frequently updated, include more exchange among people and include a higher percentage of text (as opposed to multimedia) than standard Web pages. But the exchanges on them tend to be more asymmetric (i.e., dominated by main authors) and less frequently updated than CMC sites such as newsgroups.

Blogs are especially popular among young people, and a national study of teenagers online found that those who blog are the most prolific writers in a variety of other online and offline writing. Some 52 percent of people who write for blogs, however, are age 30 or older (Rainie, 2005), and blogging activities can be developed for any age level. For example, Kleiman (2008), a librarian specializing in developing library services for older adults, recommends that older adults be taught how to create or contribute to blogs about family history, the history of their local communities or common interests such as volunteer opportunities.

Not surprisingly, educators are beginning to exploit blogs as a potential tool for teaching writing in students’ first or second language. (See, for example, Krause, 2004; Lowe & Williams, 2004; Walker, 2005.) Bloch (2007) describes the use of blogging to promote critical literacy and academic writing in a college ESL class. In the study, a class blog was created for students to read and respond to each other’s posts and later use them in their academic papers.

Bloch’s account focuses on the experiences of Abdullah, a Somali student who came to the United States as a teenager from East African refugee camps. Like many “generation 1.5” immigrants (i.e., people who move to a new country before or during their early teens), Abdullah felt most comfortable with vernacular English, but had difficulties with academic writing. At first, Abdullah drew upon his vernacular forms of literacy to write about his personal experience. Later, as he felt more comfortable in the social community of the class blog, he was able to present and argue both sides of a controversy over the use of a plagiarism detection Web site. After more blog writing on evaluations of online papers, Abdullah demonstrated “an ability to ‘weave’ the texts he had read with his own ideas, which could serve him well for meeting the course goals for academic writing” (p. 12).

Besides describing how blogging helped Abdullah to bridge from a more colloquial style of writing to a more academic style, Bloch also illustrates how blogging can be a helpful tool for discussing topics that require personal reflection from students, such as plagiarism, and for rhetorical exchange with others in ways not usually facilitated by academic writing. Bloch concludes that blogging should be seen as not only a pathway to academic writing for students,

but also as an important new literacy activity on its own, enabling students to become “contributors and not just consumers of information on the World Wide Web” (p. 138).

An excellent example of blogging in adult education comes from the United Kingdom, where Cullimore (2007) reports on the successful use of a blog called LifeChoices in instruction for adults with learning difficulties or disabilities. LifeChoices was set up as a “closed blog,” requiring a user name and password to provide a safe environment for low-literacy adults. Participants in LifeChoices came from four different classes, allowing learners to interact with others outside their immediate group. Students wrote on a range of topics related to material they were covering in their course.

Tutors reported that learners gained confidence in their communications, increased their motivation for writing, became more familiar with the Internet and more competent in using computers, and gained respect for both their own and others’ contributions. Learners were especially excited when those from outside their own class commented on what they had to say. Based on results of the project, Cullimore makes a number of practical suggestions for blogging in adult education, including providing a clear, simple list of instructions appropriate to learners about how to write on the blog; getting all learners hands-on as soon as possible to give them the experience of posting or comments; encouraging learners to post at least once weekly and ensuring that they receive a response to their postings at least once weekly; and using digital photographs in class blogs to help spark learners’ interest.

Instead of closed blogs like the LifeChoices program, some adult educators have students contribute to or create their own publicly available blogs. In vocational ESL classes, instructors sometimes emphasize that having a positive online presence can be helpful in the job market, because employers frequently Google the names of job applicants. Using the free Blogger software program (<http://blogger.com>), vocational ESL students can create public blogs on which they discuss their personal and career interests.

Mason (2006) suggests that blogging is ideal for adult learning, because it is self-directed, based on personal and workplace experience, and connected to relevant social context. Nevertheless, while blogging is a great way to develop fluency, it may not result in sufficient feedback on

form to help students develop discrete writing skills. To overcome this drawback, teacher or peer feedback can be integrated into blogging activities, or writing for blogs can be complemented by other type of writing instruction.

Wikis

Wikis are simply Web sites that any visitor can contribute to or edit (Richardson, 2006). By far the largest wiki, and one of the 10 most visited Web sites in the world, is Wikipedia. This open-source encyclopedia exists in more than 190 languages (Holloway, Božicevic, & Börner, 2007). Its English version alone includes more than 2.9 million articles totaling some 1 billion words, more than 25 times as many entries as the next largest English-language encyclopedia, the Encyclopaedia Britannica (Wikipedia, 2009c). Most remarkably, since its inception in 2001, 5.77 million contributors have made some 236 million edits to Wikipedia (Wilkinson & Huberman, 2007).

Much of the discussion about the use of wikis in education has focused on the suitability of Wikipedia as a source for student research. Jim Wales, the founder of Wikipedia, gives the most commonsense answer. He suggests that Wikipedia can help provide an overview of issues and a starting point for identifying primary sources, but students are better off using primary sources as definitive sources in their research (Warschauer & Grimes, 2007).

A more relevant question for this paper is how writing for wikis in language, composition and other courses can affect the learning process, specifically that of adults. The potential of wikis for teaching and learning is hinted at by Ward Cunningham, inventor of the wiki, who noted that that “the blogosphere is a community that might produce a work, whereas a wiki is a work that might produce a community” (Warschauer & Grimes, 2007). Cunningham’s statement illuminates a central limitation of CMC since its inception: It has served as a good medium for exploring identity, expressing oneself, airing diverse views and developing community, yet has proven unsuitable for accomplishing many kinds of collaborative work because of the inherent difficulty of arriving at decisions in groups dispersed by space and time. (See the meta-analysis comparing face-to-face and

computer-mediated decision making by Baltes, Dickson, Sherman, Bauer, & LaGanke, 2002.)

Wikis reverse traditional online writing activity in several respects. Whereas e-mail and chats facilitate informal, author-centric, personal exchange, writing on a wiki facilitates more formal, topic-centric, depersonalized writing. Each edit makes a concrete contribution to a collaborative written product, with authorships relegated to a separate page that only the most serious readers are likely to notice. This kind of depersonalized informative writing is common in the business world, and wiki writing may be effective in helping to teach it.

Though some educators are beginning to report on their experiences, publications to date mostly consist of lists of suggestions or summaries of experiences by practitioners. (See, for example, Mader, 2007, for a collection of reports from high school, college and university classrooms, and Mader, 2008, for a summary of current uses of wikis in education.) Elia (2007) reports on wiki collaboration in an ESL teacher-training workshop. Fissaha Adafre and de Rijke (2007) have done some initial work on creating parallel corpora of similar sentences in different-language versions in Wikipedia, which could prove useful for second-language education and research. Warschauer and Grimes (2007) report how an educator found wiki writing to be more motivating than conventional writing assignments; undergraduates reportedly worked collaboratively with vigor, attention and excitement to complete and flesh out a dictionary of key terms and concepts. The contributor-tracking facility of wiki software also solved the problem of individual assessment in group-project assignments, enabling the instructor to see the exact contributions of each individual in a group.

A few small studies have been conducted among English-language learners, but all have been in international English-as-a-foreign-language contexts rather than adult ESL contexts in the United States. Kessler (2009) introduced wiki-based collaborative writing among Mexican university students and found that they principally focused on producing meaning together and did not pay much attention to grammatical errors. Kovacic, Bubas, and Zlatovic (2007) carried out a variety of wiki-based writing activities among university English students in Croatia. For example, students collaboratively wrote

business letters in response to an imaginary complaint. Surveys indicated that students found the activities both highly interesting and useful, but no attempt was made to measure their learning. Mak and Coniam (2008) describe a project in Hong Kong, in which secondary school English learners collaborated via a wiki to write a brochure about their school. Over the course of the project, the quantity of students' writing increased dramatically, as did their confidence as writers of English, although the accuracy of their writing did not change much.

As yet there is no published research on using wikis to support collaborative writing in both instruction and professional development, but adult educators are beginning to experiment with the topic. Educators from two adult schools, one in California and one in Vermont, launched Coast to Coast wiki as an environment for collaborative writing among their students (<http://coasttocoast.pbworks.com/>), and an adult educator at Randwick College in Sydney, Australia has used a wiki for adult ESL students to write group reports about study and career pathways (<http://esol3-4.sydneyinstitute.wikispaces.net/Project>).

Simple English Wikipedia has been created to ensure greater access to information for English-language learners and low-literacy adults and youth (Simple English Wikipedia, 2009b). Contributors to this new version are encouraged to use more basic vocabulary and grammatical structures, avoid idioms and jargon, and write shorter articles (Simple English Wikipedia, 2009a). This simplified Wikipedia can serve as a site where prospective literacy instructors or teachers of English can practice communicating at a level appropriate for learners, a student research site for learners with beginning or intermediate literacy skills, or a place for learners with intermediate or advanced writing ability to contribute meaningful writing. For example, adult educators could have their students write or edit pieces on Simple English Wikipedia related to their hometowns, cultural backgrounds or personal interests.

Other Free Online Writing and Communication Tools and Environments

in addition to blogs and wikis, other new tools for online writing and collaboration have emerged in recent years that could be potentially valuable for adult educators.

Google Docs (<http://docs.google.com>) is a Web-based word processing, presentation and spreadsheet program offered by Google. Google Docs has several possible advantages over traditional office software for adult education programs. It is free; it requires no hard drive space to be allocated to individual users; users can access their documents from any computer connected to the Internet; and multiple users can collaborate on the same document. Google Docs thus offers the possible benefits of cost, convenience and, most important, new opportunities for collaboration.

Google (2008a, 2008b) offers some suggestions for using Google Docs in the classroom, many of which are applicable to adult education. They include promoting group collaboration; keeping track of student grades and attendance; facilitating writing as a process; creating quizzes and tests; **encouraging collaborative presentation skills**; maintaining, updating, and sharing lesson plans; and tracking and organizing cumulative project data. These tools might be of special value to adult learners and educators, who frequently attend or teach adult school part-time and who thus may benefit from tools allowing communication at a time and place most convenient to them.

Moodle (<http://moodle.org>) is a free, open-source course management system that includes modules for discussion forums, real-time chats, quizzes, wiki writing and other features found in such commercial counterparts as Blackboard. Moodle can be used to organize collaborative written discussion among students or to offer complete online courses, with interaction taking place either synchronously or asynchronously. Moodle is used extensively in ESL and adult basic education (ABE) instruction (see sample courses at <http://moodle.literacytent.org/>), and guidelines have been developed for its use in both areas (Friday, 2009; Robb, 2004).

A more elaborate online learning environment developed specifically for adult literacy learning is AlphaRoute (<http://resources.alpharoute.org/>). Though focused on Canadian-oriented content and available only to Canadian programs, AlphaRoute potentially could serve as a model for similar online environments for U.S. literacy resources and instruction. A number of research reports are available

on its use with diverse populations in Ontario. (See the listing at <http://resources.alpharoute.org/articles.asp>.)

FanFiction.net is a site for people to post fictional writing on topics related to books, cartoons, games, comics, movies and television shows. It is increasingly popular among adolescents, and adult educators may find it worthwhile to explore using the site to connect with their younger learners and improve their literacy skills. Black (2008) carried out a two-year study of adolescent English-language learners who voluntarily participated on FanFiction.net on their own time, simply to share their writing, to identify how they exploited the social, textual and technological elements of the networked community to scaffold and promote their reading and writing development. She found that the peer-review practices of the site tempered critique of form with enthusiasm for content and rhetoric, discouraged hostile feedback and attended to authors' needs as communicated in their notes or in communication between writers and reviewers. All of this, according to Black, allowed English-language learners to develop a strong sense of audience, understand the social nature of writing, explore their identity as writers and master multiple modes of representation to achieve their rhetorical intent.

There has been no similar research on FanFiction.net writing with adults or in instructional situations. However, Black's study points to some of the potential advantages of online writing exchange. For young adult learners at an intermediate or advanced level, reading or writing on FanFiction.net might be an effective way to improve literacy skills — especially because this type of activity could be carried out on an autonomous basis by motivated learners. With the escalating need to serve younger adults with experience and interest in technology, FanFiction.net and similar types of popular-culture-based collaborative writing environments could potentially breathe new life into adult literacy classes.

In summary, the collaborative writing tools described in this section are valuable for promoting writing fluency and strategies and for helping students develop a more confident identity as English writers. In general, the tools may be less useful for promoting writing accuracy or basic writing mechanics, but that will depend in part on how they are used. In contexts where a focus on mechanics and

accuracy is the principal instructional goal, teachers can set up special activities using these tools to accomplish that goal (e.g., using wikis to find and correct mechanical errors in previously written texts) or supplement the tools with other resources, including some of those described later in this paper (e.g., text-scaffolding software, automated writing evaluation software.)

Tools for Language Analysis and Structure

Most of the applications discussed above aim to promote writing improvement and fluency through increased time on task, interactive communication and language practice. However, some computer-based and online tools try to provide more direct linguistic support to students. We briefly consider text scaffolding, speech recognition, automated writing evaluation and online concordancing.

Text-Scaffolding Software

Adult students with limited literacy skills face a challenge in improving their reading. On the one hand, they need access to cognitively demanding texts to maintain their engagement and interest. On the other hand, many of these texts include too much vocabulary that is beyond their comprehension level. Literacy scholar Jim Cummins (2008; see also Cummins, Ardeshiri, & Cohen, 2008) has developed a text-scaffolding software program called e-Lective designed to overcome this contradiction, and the program is now available commercially. An instructor can import any reading text into the program, which then allows students clickable access to digitized-speech readings of any phrase; English and L1 dictionary support for individual words; cloze and other practice exercises based on learners' own vocabulary lists; a grammar mode to assist students in identifying parts of speech; language detective activities for students to explore aspects of words' meaning, form and use; and a writing mode to support students' creative response to texts they have read (DynEd, 2008). Relatively little research has yet been done with e-Lective, and none of it with adult learners.

An even newer text-scaffolding software program is under development at Educational Testing Service. The program, called Text Adaptor, is designed for use by ESL

teachers to prepare instructional materials for students, rather than for students to access directly. The program is intended to automate and simplify the process of scaffolding difficult texts by highlighting words that may be cognates in students' first language, translating texts into students' first language, identifying notable collocations or idiomatic phrases, calling attention to prepositional or nominal phrases, identifying words that may be difficult for English-language learners and suggesting alternatives, and other ways (Burstein, 2009). The program is currently being piloted with K-12 ESL teachers in the United States. Though the current version is not designed for adult education use, it is likely that such programs could be helpful to adult teachers who may lack the time or skills to do similar scaffolding procedures without the aid of software.

Speech Recognition

Speech recognition software converts spoken words to machine-readable input. IBM has developed a program called Reading Companion to exploit speech recognition for helping people learn to read. The company is making the program available free to public libraries, community colleges and agencies offering adult literacy services (IBM, 2008).

According to IBM,

Users log on to the Reading Companion web site and are presented with material to read. An on-screen mentor, or companion, "reads" a phrase to the user and then provides an opportunity for the user to read the material, using a headset microphone. Depending on the accuracy of what was read, the companion provides positive reinforcement (e.g., "You sound great!"), gives the user an opportunity to try again, or offers the correct reading of the words on the screen. As the user's skill improves, the technology reads less material so that the learner reads more. (IBM, 2008, fourth paragraph)

An evaluation study conducted by the Children's Technology Center, based on surveys, interviews and site visits, found that Reading Companion was especially

effective for helping ESL learners develop their language skills at a school or community organization. As the study points out,

They like the program because it helps them with their pronunciation. When they encounter a false negative (i.e., when the program fails to tell them about mispronouncing a word), they are unlikely to notice. When they encounter a false positive (i.e., when the program stops them and diagnoses an error even though they read the word correctly), they assume that the program is correcting their pronunciation and they appreciate it. These learners like the self-paced nature of the program and appreciate the opportunities for repetition. Many of them, especially recent immigrants, like the specific content (e.g., information about citizenship) and feel it is helpful to them. They are eager to increase their English vocabulary and asked for more books on a wider set of topics to help them expand their vocabulary. Their instructors also asked for a wider range of books, from simpler texts to highly sophisticated ones, and an index that ranks or rates the booklets by the sophistication of the vocabulary included (Brunner & Mennon, 2007, pp. 7–8)

The study found that the program was valuable as well for adult basic literacy students at a school or community organization, who also liked the self-paced nature of the program and the opportunity to master different levels of vocabulary in contexts relevant to their needs. However, adult literacy students found the false positives and false negatives more frustrating because “inaccurate feedback is more destructive in learning to read than in learning to speak a foreign language” (Brunner & Mennon, 2007, p. 8).

The evaluation suggests that owing to difficulties in installing the program and managing the interface, Reading Companion is not yet suitable for independent home use, but that if those matters can be corrected, it might be helpful in home environments as well.

In contrast to Reading Companion, which focuses on literacy development, EnglishCentral (<http://>

EnglishCentral.com) uses speech recognition to assist second language learners in improving their pronunciation and spoken language. The free online site was launched in 2009 with funding from Google. Learners choose among popular videos on the site, listen to words or sentences from them at controlled speeds, read and repeat what they have listened to, and receive feedback on their pronunciation and syntax.

Text readers are another form of speech recognition technology that can benefit adult learners. They offer simultaneous auditory and visual input without some of the feedback mechanisms described above. Comprehensive text reader packages available include Kurzweil 3000, WYNN Literacy Software, and Read and Write Gold. Harting (2007) reports that the computer lab coordinator at Second Start Literacy in Oakland, Calif., uses text-reading software to help adults with learning difficulties. In addition to using pen and paper in their writing classes, the students are given a choice between traditional, silent word-processing software and text reader software, which can pronounce words aloud. Harting reports that most students prefer the text reader because they like the positive reinforcement that comes from hearing the computer pronounce words immediately after they write them.

Automated Writing Evaluation

Automated writing evaluation (AWE) incorporates technologies that provide automated essay scoring and other types of computer-generated feedback on student writing. (See the discussion in Warschauer & Ware, 2006.) The most common AWE scoring engines assess measurable semantic, syntactic and discourse features of student essays and then assign a score based on similarity of fit on these features to previously submitted student essays scored by human graders (Warschauer & Grimes, 2008). Other programs, which mainly compare the semantic features of student texts to material from an informational database, can assign scores with a smaller training set of student essays and thus can provide scores on alternative assignments, such as student summaries of texts (Landauer, Laham, & Foltz, 2003). Both types of programs also offer a variety of feedback on the mechanics or organization of student writing.

These scoring engines are now sufficiently developed to serve as a partial substitute for human raters on national standardized exams, such as the Graduate Management Assessment Test (Burstein, 2003). They are not used in the official scoring of the essay portion of the GED test, but some companies that provide practice material and exams incorporate automated scoring of students' practice writing.

Web-based AWE programs for the classroom, which combine automated scoring, feedback to students, individual student and class progress reports for teachers, and a variety of other student writing tools (e.g., dictionaries, thesauruses, model essays, brainstorming tools), are now available as well (Warschauer & Grimes, 2008).

A few recent studies have reported positive effects on student writing or language arts outcomes from the use of AWE. (See, for example, Franzke, Kintsch, Caccamise, Johnson, & Dooley, 2005.) The research record on this issue is limited, however, and far from definitive. (For an overview, see Warschauer & Ware, 2006.) Other recent research, such as a case study of AWE use in culturally and linguistically diverse middle school classrooms in California, suggests that English-language learners and other seventh- and eighth-grade students appreciate the rapid and impartial scoring and feedback and are thus more motivated both to write and to revise their writing (Grimes, 2008). According to this study, use of the software helped keep students engaged in writing and revising, freeing teachers to aid individual students as needed and to be more selective in grading student work (e.g., to comment on and grade only a final draft rather than multiple drafts of a paper). Another recent study, based on ESL instruction in a Japanese university, had similar findings. There, implementation of AWE was most successful when computer-based scoring and feedback on earlier drafts of writing was combined with teacher response to later or final drafts (Chen & Cheng, 2008).

Though AWE programs are increasingly used (albeit at a still low level) in K–12 schools and universities, we are not aware of any use or research in adult language and literacy education. Many adult language and literacy programs may not find them suitable, but those focusing on writing skills may wish to consider them.

Online Concordancing

Computer-based concordancing provides an alphabetical index of all words in a text or corpus of texts, showing every contextual occurrence of a word. After a word or a phrase is entered into a concordancer, a selection of the sentences from the corpus containing the word or phrase appears. Concordancing is therefore ideal for checking collocation, the way words co-occur in a predictable pattern. Teachers also can use concordancing to help learners notice and record the most useful terms in a text.

Though concordancing has been used in language learning for some 20 years (see, for example, Tribble & Jones, 1990), two recent developments greatly enhance its accessibility and scope. The first is that concordancing tools and large-scale corpora are now accessible for free on the World Wide Web. Previous use of concordancers involved installing special software on individual computers and developing or purchasing specialized corpora. Today, any teacher can introduce concordancing to students simply by pointing to free online sites such as Corpus Concordance English (http://www.lexutor.ca/concordancers/concord_e.html). These sites allow students to investigate immediately how particular words or phrases are used in context and with what collocations they tend to occur. Second, whereas early large-scale corpora were based exclusively on written texts, there are now corpora of spoken texts, such as the free online Michigan Corpus of Academic Spoken English (<http://quod.lib.umich.edu/m/micase/>), which includes 1.8 million spoken words searchable by gender, age and position or role of the speaker, as well as by category of speech event.

Concordances often can be confusing to students. Although search words appear in multiple contexts, many of the contexts are unfamiliar to the students, and the sentences presented are often **short, incomplete and isolated** outside a storyline (Cobb, 1999). Teacher guidance that provides general direction for students, but leaves them enough room to explore on their own, can be helpful (Kennedy & Miceli, 2001; McEnery & Wilson, 1997).

Teachers can take a more directive role by performing concordances themselves and providing the data to students, either through printouts or online links. For example, Gaskell and Cobb (2004) conducted a study in a lower intermediate-level English writing course at a

university in Montreal, Canada, that provided concordance information as feedback on students' sentence-level written errors. The researchers collected data from 20 adult Chinese English-language learners between the ages of 18 and 50. During the 15-week period, the instructor gave feedback on each student's assignment, including online concordance links for five typical errors. The students then revised the text for final submission, and for each of the concordance-linked errors, they submitted a form explaining specifically what correction had been made based on what concordance information. In the end-of-course survey, all 20 students stated that they had learned a great deal and felt their English writing skills had improved. More than 50 percent responded that they felt their ability to use much of the grammar targeted in the course had improved as well. Eight of the 20 learners (40 percent) attributed their improvement specifically to the concordance work and believed they would continue to use concordancing as a learning tool in the future. These findings provide evidence for the potential advantage of using concordancing tools for adult literacy learners, although no research has been conducted yet among that population.

In summary, language analysis and structure tools offer direct linguistic support to literacy and language learners. Learners can access an array of online tools to help them check collocations and idiomatic phrases, identify parts of speech and get feedback on their pronunciation and writing. Using these tools may require instructor guidance at first, but with practice, students may learn to use them to support their language and literacy development both in and out of class.

Online Networking

Immersion has long been an effective approach for aiding language learning, whether it is immersion in a foreign country or immersion in a bilingual classroom. Similarly, adult literacy can be promoted through immersion in contexts requiring authentic reading, writing and other meaning-making activities. (See, for example, Elish-Piper, 1995, 1996.) Today, emerging technologies can provide new forms of immersive learning online. We consider three prominent applications for immersive learning: virtual environments, social network sites and multiplayer online games.

Virtual Environments

Multiuser virtual environments allow interaction among people in digitally simulated contexts. One of the most popular and best-known sites, Second Life, brings together tens of thousands of users daily who design avatars, build communities and interact with the environment. The stimuli-rich Second Life environment offers a variety of opportunities for second-language learners to produce language. In Second Life, English learners can work with other learners and with native English speakers, collaborate to create objects, role-play situations such as ordering at a restaurant, and participate in scavenger hunts and guided tours (Silva, 2008). These Second Life experiences then can be shared in a language classroom via presentations and essays.

A rapidly expanding cottage industry is emerging within and around Second Life to promote second-language learning (Cooke-Plagwitz, 2008; Stevens 2008), and other virtual environments are being used for language teaching and learning as well. These environments potentially combine the advantages of several other types of online applications. First, as in Web-based searches, users can seek and use information on a variety of topics. Second, as in multimodal production, users can create and post content. Third, as in CMC, users can interact with others. Thus, language and literacy activities such as WebQuests (which send users to Web sites to find information) can become Second Life quests, in which students can adopt new identities and interact with others as part of their online investigation. An annual SLanguages Virtual Conference (<http://www.slanguages.net/home.php>) brings together educators and researchers to develop and improve language learning and teaching methods within Second Life and other virtual environments.

Several other virtual environments also are being used or developed for language learning. Sykes (2008), who established a virtual environment for learning Spanish called Croquelandia and studied it in her doctoral research, suggests that these environments offer three potential benefits for language learning (Sykes, Oskoz, & Thorne, 2008). First, by adopting simulated identities, students can experiment with and practice pragmatic language functions in diverse social contexts and settings. Second, students can engage in meaningful language practice in

low-risk contexts, for example, by practicing authentic ways of apologizing without having actually offended a real person. Third, the situated realism of virtual environments can help students develop an emotional connection to the language they use and to language learning more generally, because it allows learners to feel as if they were really there.

As with many other aspects of emerging technologies, the possible benefits of language learning through virtual environments have not yet been verified through research, especially in adult literacy or second-language learning contexts. Nevertheless, they appear to hold potential, especially for work with young adults.

Social Network Sites

Social network sites are Web-based services that allow users to create digital identities for themselves, list other users with whom they have relationships or connections, and view and communicate with these and other users all within a bounded system (Boyd & Ellison, 2007). Since their advent in the late 1990s, social network sites have logged approximately 250 million unique visitors (Halvorsen, 2009), of which Facebook alone claims 55 million active users. In 2008, it was estimated that in nearly 44 percent of adults and 77 percent of Internet users would visit a social network site at least once a month (Salaway, Caruso, & Nelson, 2008), though the extent of use among adults with limited literacy or English language skills was unknown.

What began as a tool to help friends and affiliates connect and send messages to each other has now evolved into a complex, globally ubiquitous system that serves many purposes, from marketing (bands on MySpace) to professional networking (LinkedIn). Several social network sites have been set up specifically to connect language learners and mentors in English and other languages, including Livemocha, Lang-8, Mixi and Praxis Language. These sites usually combine access to self-study material and opportunities to practice and communicate with others through peer-to-peer or peer-to-mentor synchronous or asynchronous interaction.

Two studies have been done on the use of social network sites for language-learning immersion, both in foreign language contexts. Halvorsen (2009) carried out a small pilot project involving his university ESL

students in Japan. During the course, the students were instructed step-by-step on how to sign up for and log into MySpace, customize pages and backgrounds, enter basic personal information in the profile section, and manage and maintain friend lists. The blogging feature of MySpace was introduced, and the students learned to record and upload audio files to their MySpace pages using Audacity software. Afterward, the students were required to create and maintain MySpace pages using all of the tools integrated therein, such as chats, blogs, audio and video uploads, and, of course, e-mail. Three important course components were the creation of and response to blogs on a variety of topics; recording and uploading of student-generated audio files; and cross-cohort interactions between students from two classes using chat, e-mail and responses to blogs—all of which were to be accomplished in English. Halvorsen found that the study encouraged student creativity and autonomy, as well as student collaboration both face-to-face in the classroom and on MySpace, especially among mixed-ability language learners, with peer support increasing and students taking on the role of mentor.

Harrison (2008), also based in Japan, had his students sign up for Livemocha (<http://www.livemocha.com/pages/about>) as a supplementary language-learning tool in a university course. In Livemocha, learners can study languages through audiovisual lessons and interactive tools, while also interacting with people who want to help tutor the language. Limited results were achieved in Harrison's course within a three-month period, due partly to issues of trust with unknown distant mentors.

Contrary to what the name suggests, most users of social network sites are not necessarily looking to network with or meet new people. Instead, they are interacting with people who are already part of their extended social network. For example, research conducted in the United Kingdom suggests that adults use social network sites principally to manage their existing relationships and to get back in touch with old friends (Office of Communications, 2008). This suggests that Halvorsen's approach (above), using a social network site to link students in a school, may be more effective than Harrison's, in which students are sent to social network sites to find distant mentors. These links can be accomplished on

publicly available sites or on special sites created by teachers using software that allows users to develop new social network sites for specific purposes and groups (e.g., Ning at <http://ning.com>).

We are not aware of any social network sites that have been set up specifically for use by adults with low literacy levels. The use of social network sites, however, appears to have some potential value, both to give students more opportunities for reading and writing authentic material related to their personal lives and to develop student mastery of a tool that they can use for personal or professional networking. In addition, social network sites provide learners with environments in which they can take more control of their own learning and possibly find others to help them in their language development (Harrison, 2008). This may develop adult students' skills in self-directed learning, an important life skill that goes beyond language competence (Smith, 2002). Many adults also may have an interest in learning about social network sites to better understand their children's activities online. An additional benefit for adult ESL learners might be linking with friends and relatives in their home countries.

Multiplayer Online Games

Multiplayer online games have captivated people of diverse ages. The most popular genre involves large numbers of participants in role play. Some 16 million people around the world are involved in these massive multiplayer online role-playing games (MMORPGs), including 10 million players of a single game called "World of Warcraft." Gee (2003, 2004, 2007), a cognitive psychologist and literacy theorist, posits that much of the appeal of these games lies in their learning mechanisms. He claims that while such games are challenging, they provide the types of scaffolding necessary—through multistep levels of difficulty, diverse forms of multimedia support and potential assistance from other players—for people to progress steadily through them, thus making learning both efficient and enjoyable.

Gee's theoretical work in this area is extended by Steinkuehler's (2007) two-year ethnographic study of literacy practices among MMORPG players. Steinkuehler argues that playing these games is a literacy activity in itself, based on how gamers must continually "read and write" meaning within this complex semiotic domain,

since every successful move requires both recognizing and producing meaning out of an overwhelming array of multimedia, multimodal resources. As for more traditional types of literacy, Steinkuehler found that players read and wrote copious amounts of text while playing: Communication in the game they played was largely text-based, involving letter writing (using the in-game mail system), narrative and poetry (shared with others through text chat), and instructional practices (apprenticeship, mentoring). Her study concluded that such games help players develop the types of authentic, creative and wide-ranging literacies that schools purport to value.

A small pilot study was carried out to investigate the potential of MMORPGs for second-language learning. A group of adult ESL learners at a university was recruited to play a fantasy game called "Everquest II"—which is based on alternative universe races among elves, dwarves, ogres and other characters—for at least four hours per week (Waters, 2007). Unlike "World of Warcraft," "Everquest" has extensive audio built in, as well as visual labels for all items in the game. The study found that carrying out tasks in the game and being exposed to both visual and auditory reinforcement in the process assisted players in developing vocabulary, but not necessarily grammar. Also, at least in this study, only students with an intermediate level of English or better could benefit from the immersive experience.

Nobody expects U.S. adult education programs to start massively signing up their students to play "World of Warcraft" or "Everquest" in class. The challenge, rather, is to develop new games that match educational content with the types of learning principles embedded in commercial online games. Developing these educational games will likely be a challenging long-term enterprise, but the potential value of what are called "serious games" is such that there is substantial interest in them in fields ranging from professional training, military training and health care to advertising and public policy.

One-to-One and Mobile Computing

Some of the more traditional computer-based learning activities, such as drill and practice software, were intended to be used as an occasional curricular supplement. The emerging technologies discussed above, however, generally

require regular online access to achieve their educational potential. A major benefit of using these new technologies is fostering autonomous technology-based literacy among users. It is difficult to foster this autonomy if students can access a game, simulation, blog or wiki only occasionally in a computer lab.

Fortunately, emerging developments in hardware may enable adult literacy and adult ESL programs to provide more consistent, flexible technological access on an individual and mobile basis. Emergent devices potentially affecting the educational sector include netbooks and smartbooks, nettops, rich clients and cell phones. Each is discussed below, followed by a brief discussion of open-source software and cloud computing.

Netbooks and Smartbooks

A decade ago, 20 percent of computers purchased were laptops. Today laptops are the majority, as they have steadily fallen in price and improved in performance, thanks in part to the broad availability of wireless networks (Computer Economics, 2005). The recent emergence of netbooks (Vance & Richel, 2009)—leaner-functioning notebook computers designed for Internet-centric work—is beginning to hasten laptop use in schools. Many believe that the low cost, light weight, portability and long battery life of netbooks make them ideal for education. With more than two dozen netbook models either on the market or upcoming (for a list and specifications, see Wikipedia, 2009a), both K–12 and adult literacy and adult ESL programs will have increased options for low-cost computing.

Netbooks will soon be joined by even lower-cost notebook computers sometimes referred to as smartbooks, which will combine the form of a small laptop with the processors typically used in cell phones. These smartbooks will feature even lower cost and longer battery life than netbooks. The use of free Linux-based operating systems, including a new operating system under development by Google, will further hold down the costs of these new mini-laptops.

The affordability of low-cost laptops using free software (see discussion below) makes possible expanded laptop use in adult education, including one-to-one programs in which all students are provided individual laptops. Though

there is no research yet on such one-to-one programs in adult education, there is an extensive body of research on one-to-one laptop programs in K–12 schools, including in language and literacy education. Three recent rigorous studies, taken together, tentatively suggest a positive impact on student test scores from laptop use. In Maine, where all seventh and eighth graders are provided laptops, eighth graders' test scores in writing rose by one-third of a standard deviation from 2000 to 2005; students whose teachers made the most extensive use of laptops in writing instruction showed the greatest gains (Silvernail & Gritter, 2007). In a California school district, after two years, students using laptops in the fourth grade showed greater improvement in English language arts test scores, reading comprehension and writing strategies than those not using laptops (Suhr, Hernandez, Grimes, & Warschauer, 2010). And a large study in Texas found a positive laptop effect on reading comprehension among middle school students, though not at a statistically significant level; students who used the laptops most for academic purposes, especially at home, showed the greatest gains in reading (Texas Center for Educational Research, 2008).

Beyond test scores, a number of benefits of laptop use have been reported in multiple K–12 studies. These include improved technological skills (Schaumburg, 2001; Texas Center for Educational Research, 2008); decreasing gaps in technological proficiency between economically advantaged and disadvantaged students (Texas Center for Educational Research, 2008); heightened student engagement and motivation (Silvernail, 2007; Warschauer, 2006); and decreasing student disciplinary problems (Texas Center for Educational Research, 2008). Problems associated with laptop programs include their costs, the strain they put on technical support personnel, and the time and costs associated with professional development and curriculum development.

A *New York Times* article, based largely on a report from a single high school, suggested that many schools are dropping laptop programs owing to dissatisfaction with results (Hu, 2007). But a recent survey of 364 superintendents, curriculum directors and technology directors of school districts throughout the United States found that was not the case (Greaves & Hayes, 2008). The authors found that laptop programs are growing steadily

in schools and are now being implemented at some level in more than one-quarter of the districts surveyed. Of the districts tracking the impact of laptops on academic improvement, 91.8 percent reported a significant or moderate positive impact, with the percentage reporting a significant effect on improved learning nearly doubling from 2006 to 2007. For districts without laptop programs, cost was, by a substantial margin, the most frequently reported factor influencing the decision not to start a program, with doubts about the academic value of laptop programs listed least frequently of six factors.

Several lessons learned from K–12 laptop programs could benefit adult education programs. These include aligning the laptop program with key goals; planning logistical details carefully; planning for long-term funding, including not only the computers but also network connections, increased bandwidth, software, technical support and professional support; providing training and professional development on curriculum integration, not only on technical skills; developing solid partnerships inside and outside the school system; providing necessary digital content and tools; maintaining the requisite network infrastructure; allowing sufficient time for gradual implementation; and conducting research and evaluation studies (Warschauer, 2005; Zucker, 2005). The applicability of these research findings to adult literacy instruction is not yet known.

Nettops

Many adult education programs have large numbers of short-term, part-time students with high rates of turnover. These programs may not find it practical to allow students to take laptops home, thus eliminating one of the main advantages of laptops, their mobility. As an alternative, adult education programs may want to expand their use of desktop computers.

Taking advantage of the same chip technologies used in netbooks, several companies are developing low-cost desktop versions, called nettops. At least a half-dozen products are currently on the market or forthcoming (for a list, see Wikipedia, 2009b), with prices for a basic unit under \$250 (Richtel, 2008).

Nettops have not yet been deployed in U.S. schools, but the Indiana Department of Education has launched

a large statewide program based on similar inexpensive desktop computers using open-source software and operating systems. (For a detailed description, see Indiana Department of Education, 2008.) A major focus of the program is language arts classrooms. The intent of the program is to achieve the benefits of one-to-one computing at a lower initial and ongoing cost than through programs based on laptop computers with commercial operating systems and application software.

Rich Clients

“Thin clients” are computers with virtually no independent processing power; they function through the operation of applications on a central server. Operating a network of thin clients, rather than traditional desktop or laptop computers, saves a good deal of time and money because individual copies of software need not be maintained on computers. However, the use of thin clients usually comes at a great cost in flexibility and performance.

More recently, though, thin clients have been superseded by what are called “rich clients” (also called “thick” or “fat” clients). These computers also must be at least periodically connected to a central server, but they can carry out more independent processing and applications without that connection. And, unlike thin clients, rich clients enable users to display streaming video, create multimedia presentations and engage in complex simulations and games. Like thin clients, rich clients have the advantage of maintaining almost all software on the central server, thus facilitating maintenance, technical support, security and virus protection.

The Lemon Grove School District in California has implemented a “one-to-two” (one computer for every two students) computing program for its K–5 students, using rich client desktop computers, and a one-to-one computing program for all students in grades six through eight, using a mobile wireless rich client tablet called the e-Pad, which students can take home. (For details, see Anastos & LaGace, 2007.) Most of the software used, including both standard productivity tools and educational applications, is maintained on central servers, though smaller applications are maintained on the e-Pad chip.

A specific goal of the e-Pad program is fostering greater out-of-school learning. Yet the e-Pad has limited

functionality when it is not connected to the district server or the Internet. To allow at-home access via students' e-Pads to the Internet and to district programs, files and applications, the district has partnered with a local cable company to provide filtered broadband Internet access to all students' homes. The district pays about \$10 per month per student for the service, and there is no cost to students or their families. Such a model may be especially relevant for adult students who attend class a few hours a week, but who could maximize their learning through greater educational activity outside of school. Whether using traditional laptops, netbooks or rich client tablets, school or district funds spent on Internet access for students (who then access applications on the Internet or on school or district servers) could help reduce costs for commercial software programs that otherwise would be required on individual student machines.

Though there has been no published evaluation of the Lemon Grove rich client program, the district reports improved student attitudes and motivation, increased attendance and higher English language arts test scores for students in a three-year pilot one-to-one program compared with students not in the program (Lemon Grove School District, 2008).

Cell Phones

Other interconnected mobile devices include a wide range of hand-held computers, personal digital assistants, smart phones and cell phones. Most of these are unlikely candidates for use in adult education programs because their cost-benefit ratio cannot compete with that of more fully functional, low-cost computers. (See discussion in Warschauer, 2006, about the limitations of hand-held computers in education.) Cell phones, however, may be an exception, because they already are widely owned by U.S. adults, with estimates of U.S. market penetration ranging from 75 to 90 percent. (See, for example, Horrigan, 2008; TNS Canadian Facts, 2008.) Moreover, most students and teachers are already familiar with their interface and operation. The use of cell phones to deliver educational content and services has advantages over the use of textbooks, which require more time and cost to update, print and distribute. Because cell phones can be accessed

anywhere and anytime, using them for learning activities can be an attractive option for busy adult learners.

Some applications under development for cell phones include collaborative content development, as students contribute to collective Web sites by sending text messages, pictures or video from their phones (Attewell, 2005; Gromik, 2009; Tribal Education Unlimited, 2009); vocabulary learning activities through exercises, quizzes, and a flashcard system and games (Browne & Culligan, 2008; Thornton & Houser, 2005); and task-based language learning activities through graphical games (Kam et al., 2008).

Major purported benefits of these applications are the convenience and accessibility to students of material provided via cell phone, both inside and outside the classroom. For example, Browne and Culligan (2008) have developed a free software program capable of measuring and tracking the user's vocabulary size, identifying high-frequency words yet to be learned and making vocabulary lessons available via both cell phone and computers. Teachers also can log in and track vocabulary test scores of their students. With the 100 percent ownership rate of cell phones by Japanese college students, Browne and Culligan hope to create a new type of self-access center. Another study in Japan found that college students prefer to receive language-learning materials via their phones rather than via their computers, and they also learn material better when it is presented via phones rather than via paper or the Web (Thornton & Houser, 2005). In Canada, a mobile learning project involving adult ESL learners was implemented (Ally, Schafer, Cheung, McGreal, & Tin, 2007). Participants were given access to mobile phones that they used to complete 86 interactive grammar lessons. Comparisons between pre- and post-tests on the material showed an 18 percent increase in test scores, although no comparison was done on learning the same material via a different medium. A survey of the students indicated high satisfaction with the mobile lessons, especially for their easy accessibility for flexible "anytime/anywhere learning."

Whether adults in U.S. language and literacy programs also find learning by cell phone beneficial is yet to be determined. A project designed to eventually provide phone-based ESL instructional material to Hispanics in

migrant farming communities (Kam, 2008) may shed further light on the value of cell phones in U.S. education.

One relevant project carried out in the United States—albeit focused on adults’ literacy support for their children rather than adult literacy per se—is the Public Broadcasting System (PBS) “Ready to Learn” program. This project involved streaming two types of material over cell phones to parents of preschoolers: literacy tips, which gave parents suggestions on how to incorporate letter recognition and letter sound activities into everyday routines with their children, and letter video clips, which were intended for parents to show to children and included “Sesame Street” material about a different letter every day. To evaluate the project’s effectiveness, a study was conducted using surveys, interviews and an automated system that tracked participants’ streaming of literacy content to their cell phones (Horowitz et al., 2006). Findings revealed that the participants found the intervention to be a positive experience, especially for their children. The parents and children reacted enthusiastically to receiving early literacy content via cell phone. Parents reported that their children benefited from the program and that the children were eager and excited to view the letter video clips. (Some parents reported that each time the phone rang, their children came running, hoping the call was from Elmo.) Despite technical drawbacks, such as slow loading of video clips and quick draining of batteries during video streaming, the researchers conclude that cell phones have the potential to be an effective medium for delivering PBS “Ready to Learn” content to parents of preschool children and to the children themselves.

Open-Source Software and Cloud Computing

Implementation costs for one-to-one programs with many of the above devices can be reduced through the use of open-source and cloud-based software. Many educators prefer the use of open-source, Linux-based operating systems to Windows-based operating systems on netbooks and smartbooks because the former are free, secure from viruses, stable and place few demands on limited processing resources. Free open-source versions are available for most of the productivity or educational software typically used in adult education programs (e.g., Open Office; for a comprehensive listing, see <http://www.schoolforge.net/>).

In addition, an increasing number of free applications can be accessed and used over the Internet, such as for word processing (e.g., Google Docs, discussed earlier), spreadsheets, slide presentations, e-mail or photo editing. The use of Internet-based applications, files and other resources is often referred to as “cloud computing” and is expected to grow dramatically in the coming decade. Several K–12 school districts in the United States are now implementing one-to-one computing initiatives based on netbooks and open-source or cloud-based software, and initial reports are positive (Warschauer, 2009).

In summary, the biggest advantage of mobile, one-to-one computing is that it provides anytime/anywhere accessibility for busy adult learners. Many adult learners are trying to manage busy schedules involving work, study and family obligations. New mobile technologies can allow them to take advantage of learning resources and opportunities at their convenience. Low-cost computers, open-source software, cloud computing and cell phones all represent ways to bring affordable one-to-one access to students.

Emerging Technologies in Professional Development

New technologies have not yet been adequately integrated in adult education programs (Rosen, 2000; Stites, 2004; Strawn, 2008). In some cases, this is due to lack of sufficient technological resources, but even when resources are present, teaching staff may lack the time, knowledge or incentives to make good use of them. Many adult education staff, especially those who did not use computers much in their own education, may consider themselves “technology outsiders” poorly equipped to teach younger adult learners (Strawn, 2008). Even those who are proficient computer users may lack experience in the pedagogical uses of technology. A national survey assessing adult educators’ experiences, needs and preferences for professional development found that 53 percent of respondents wanted to learn to incorporate technology into instruction. “Integrating technology into the classroom” was the second most common professional development activity teachers desired (Sabatini et al., 2000). Substantial professional development thus will be needed to support adult educators in using new

technologies in teaching (Stites, 2004). The fact that many instructors in ABE and adult ESL programs teach in one or more part-time positions underscores the need for professional development, yet also suggests that providing it will be challenging.

Fortunately, the emerging technologies discussed in this paper also can provide opportunities for professional development. In particular, they can make resources and networking opportunities available online, thus extending professional development outside the school environment, as described below in a few examples of blog, wiki and Moodle use among literacy educators.

Two excellent examples of blogs for facilitating the exchange of information among adult educators are the Adult Literacy Education blog by David J. Rosen (<http://davidjrosen.wordpress.com/>) and the Adult Education and Technology blog by Marian Thacher (<http://mari-anthacher.blogspot.com/>). Both blogs contain thoughts and reflections about adult education and technology. They also include links to Web sites of adult education programs, blogs set up by other adult educators, online resources for adult education and their latest publications. Readers can use them to keep up with the latest development in politics, research and technology related to adult education, or they can simply learn how the bloggers write or think on these issues.

The Adult Literacy Education (ALE) Wiki, created by David J. Rosen in 2004 and later developed by many adult literacy practitioners and advocates, today has more than 900 registered users, nearly 1,000 pages and more than a million page views (Rosen, 2007). The ALE Wiki is a free, online environment shared by people interested in ABE, adult secondary education and English-language learning. The ALE Wiki includes discussions and resources on topics ranging from adult basic literacy to assessment, workforce and workplace education, and public policy (see http://wiki.literacytent.org/index.php/Main_Page).

Blogs and wikis can be used as a writing environment for participants in professional development workshops. For example, a teacher training coordinator for adult ESL teachers in the Los Angeles Unified School District uses the free "pbwiki" (see <http://pbworks.com/academic.wiki>) for ESL teachers to post their reflections on workshops they attend (see <http://eslacademy.pbworks.com/>).

Moodle can be used to host online professional development courses for adult educators, allowing them to access course material anytime and anywhere. For example, several free Moodle-based professional development courses are offered through LiteracyTent, including courses on foundations of teaching ABE, workforce development in ABE/ESL programs, integrating career awareness into adult education and use of new technologies in adult language and literacy instruction (see <http://moodle.literacytent.org>).

In summary, although the need for professional development for adult educators in integrating technology into instruction is great, new technologies also can be used as a medium for professional development, providing educators with both accessible information and hands-on experiences with the same tools they may later use with their students.

Conclusion

The emerging technologies discussed in this paper are all rapidly evolving. Many have been little investigated or, in some cases, not examined at all in adult education settings. None are so demonstrably successful in adult language and literacy programs that educators should feel compelled to adopt them immediately.

Yet while overexuberant adoption would be a mistake, so too would be failing to recognize the long-term potential of these technologies for adult language and literacy instruction. Many adult students have had difficulties with traditional education and face substantial barriers to learning. The emerging technologies described above provide nontraditional means by which literacy and language skills can be developed through authentic communication, collaboration, networking and scaffolding. These technologies give learners vast opportunities to use English on a daily basis in meaningful contexts in and out of school. **And in a world where hardware, software and connectivity prices are steadily falling,** new technologies are playing an increasingly vital role in business, academic and civic affairs. Educational applications of digital media are growing in sophistication, and young adults are coming to school with considerable technological experience and ease. Moreover, the cost-benefit

ratio of integrating digital technologies into education is steadily improving. It is possible to imagine a day in the not-too-distant future when some kind of mobile computing device, no more expensive than a couple of textbooks, will be as commonplace in the classroom as pen and paper are today. These devices will be used to carry out many of the above-described functions within a single integrated environment.

We need not rush this future, but we should begin to prepare for it. Research and development efforts that help adapt emerging technologies for use in adult language and literacy contexts, and then systematically investigate their impact on learning processes and outcomes, will pave the way for the kinds of adult language and literacy education needed in the next decade and beyond.

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