Photo Illustration by Randy Lyhus, © 2005

ENABLING MOBILE LEARNING

By Ellen D. Wagner

There is a sense of anticipation in higher education technology circles these days, a feeling of prickly excitement that hasn't been experienced since the heady days of the dot-com boom. For the past five years, the landscape has been littered with funding shortfalls, problems with network capacity and security, and the never-ending scramble of trying to stay ahead of maintenance and upgrade curves. Today, there is a new buzz in the air—along with a growing cacophony of beeps, ring tones, vibrations, and occasional random sound effects that startle and amuse.

Ellen D. Wagner is Senior Director of Global Education Solutions at Macromedia.

© 2005 Ellen D. Wagner

The mobile revolution is finally here. Wherever one looks, the evidence of mobile penetration and adoption is irrefutable: cell phones, PDAs (personal digital assistants), MP3 players, portable game devices, handhelds, tablets, and laptops abound. No demographic is immune from this phenomenon. From toddlers to seniors, people are increasingly connected and are digitally communicating with each other in ways that would have been impossible to imagine only a few years ago.

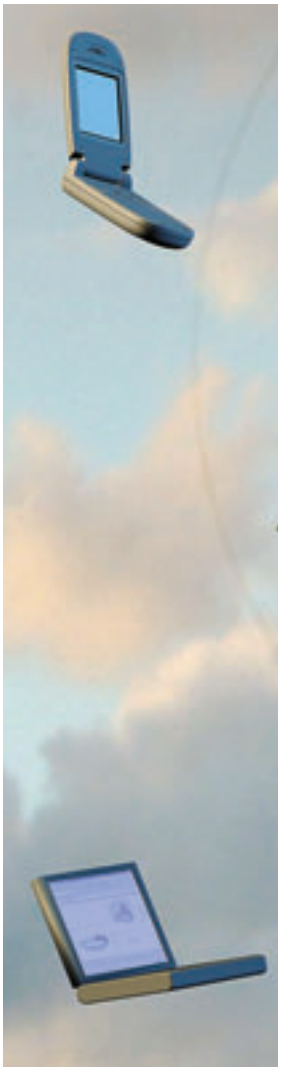
The Current Mobile Landscape

Even though mobile networks and services in the United States are just at the beginning of broadband *and* broad-scale adoption, mobile technologies clearly have already changed life as we've always known it. Using a Global Positioning System (GPS) means never getting lost again. Radio Frequency Identification (RFID) transponders have revolutionized inventory and supply chain management—not to mention the simple measure of convenience they provide to weary commuters for on-the-fly payments of bridge and highway tolls. Bluetooth technology makes it possible to create personal area networks (PANs) among physically proximate devices, connecting headset device to phones, which can in turn connect to a computer, a PDA, and any other nearby Bluetooth-enabled device. Instant messaging (IM) enables real-time and often simultaneous connections among coworkers, friends, and family wherever there is access to a wireless communication network. Automotive manufacturers are talking about turning the car into the next wireless services transceiver. Apple iPods have managed to make pocket-sized mass storage devices very hip and unmistakably trendy. Who among us isn't intrigued at the prospect of carrying our collections of music, photos, images, books, and documents literally in our pocket or purse? And it doesn't hurt that those immediately recognizable white ear-buds provide tangible evidence that the wearer is numbered among today's digital cognoscenti.

Of course, persistent connectedness offers other value as well. GSM cell-phone signals—or the lack of signals—were used to track tsunami survivors and to identify victims during recent recovery efforts in Sri Lanka. RFID tags are being attached to pets—and increasingly, even to children—for protection against abduction. An *Economist* magazine excerpt reprinted in the March 15, 2005, issue of the *San Francisco Chronicle* described a number of ways in which communities of faith are using mobile technologies.[1] For example, Catholics can now sign up for daily inspirational text messages from the pope simply by texting "Pope On" to a special number (for example, in Ireland, the number is 53141). Muslims around the world can use the F7100 handset—launched in July 2004 by LG Electronics of South Korea—both to remind themselves of prayer times (the phone has an alarm system that works in five hundred cities) and to find the direction of Mecca using the built-in compass in the handset.

Still, the anticipated arrival of WiMAX (wireless broadband) raises questions regarding the *liabilities* of being "always on, always connected." Being tethered by the electronic leash of an "always on" smartphone, where one is expected to be "always available," can extend the workday in fairly disconcerting ways. Extending the reach of "anytime, anywhere" access to learning resources raises inevitable questions about whether or not wireless access in the classroom will encourage or enable cheating. Will brevity of expression—characteristic of wireless communication—trump depth of knowledge? Will the "filter generation"—learners who multiprocess and multitask using multiple media—learn how to think critically and communicate effectively while using today's and tomorrow's digital tools?

Who among us isn't intrigued at the prospect of carrying our collections of music, photos, images, books, and documents literally in our pocket or purse?



Why *Not* Mobile for Learning?

As mobile connectedness continues to sweep across the landscape, the value of deploying mobile technologies in the service of learning and teaching seems to be both self-evident and unavoidable. And why shouldn't mobile learning accept its place in the spotlight as the "educational revolution *du jour*"? Using portable devices to support teaching and learning is not a new concept in educational circles. Robby Robson notes that graphic calculators were a revolutionary addition when they were first introduced to the classroom a few decades ago but are now often a requirement for statistics and business classes.[2] The use of PDA-based performance tools to support classroom instruction and on-the-job training alike has been well under way for a number of years, particularly in the fields of medicine and allied health, business, and journalism. Currently, laptop computers used in higher education settings outnumber desktop and laboratory computers on campus, while notebook computers are ranked as the most important hardware issue on campus today, followed in second place by—you guessed it—cellular telephones.[3]

Bryan Alexander's descriptions of "m-learning"

define new relationships and behaviors among learners, information, personal computing devices, and the world at large. The mobile learning landscape he envisioned as recently as August 2004 was described primarily in terms of mobile laptops and handheld computers.[4] Until the early months of 2005, there would have been no strong reason for looking beyond notebook and handheld computers—at least not in North America. However, with the expansion of 3G (third-generation) networks and the increasing availability of "smartphones"—integrated communications devices that combine telephony, computing, messaging, and multimedia—users in Asia and Europe are finding that their broadband connectivity *and* their computing needs can be met through a single device. And increasingly, that device is a mobile telephone. U.S. mobile users are starting to get some tastes of what mobile multimedia looks like with the growing adoption of GSM telephones with Multimedia Messaging System (MMS) functionality, but the U.S. wireless service providers still do not offer the kind of broadband distribution capacity needed to ensure a high-quality experience for mobile users. Nevertheless, advancements in embedding rich media players, such as the Web-ubiquitous Macromedia Flash, in handsets and computers have gone a long way toward mitigating bandwidth limitations by enabling rich, engaging presentation layers on a wide variety of mobile devices, regardless of the form.

Whether we like it or not, whether we are ready for it or not, mobile learning represents the next step in a long tradition of technology-mediated learning.

The heightened interest in mobile possibilities for teaching, learning, and research can be attributed to a number of factors: the continuing expansion of broadband wireless networks; the explosion of power and capacity of the next generation of cellular telephones; and the fact that mobile telephones, a familiar tool for communications, are already fully ingrained in contemporary life as part of our social practice. In other words, unlike most other mobile devices used in education, devices such as PDAs or tablet computers, there is very little extra effort required to get people to adopt and use mobile phones. Rather, people can be offered more things to do with the mobile phones to which they are already attached and with which they are already reasonably competent.

Nevertheless, when it comes to mobile adoption, the United States is relatively behind the curve. The broadband, multimedia connectedness now taken for granted by the typical Korean or Nordic citizen is something that most U.S. citizens are not likely to see for some time. As a result, U.S. educators are finding themselves in the awkward position of knowing that the mobile revolution is coming, without really being able to imagine what it's going to look like or what the possibilities for mobile learning may be.

Robby Robson and I recently presented an EDUCAUSE NLII meeting session on the coming of age of mobile learning. As we shared what we called our "insiders' view" on where mobile learning is headed—with my view based on the Macromedia Flash research and development in which my company is involved and with Robby's view based on his work as chair of the IEEE Learning Technology Standards Committee—Colleen Carmean, a session attendee, made the following observation in her conference weblog: "Scanning international horizons makes them [Robson and Wagner] much more optimistic than the people in the room, but they seem to sweep away much of the resistance and heel-digging, as they ask us to clap our hands, say 'I believe,' and imagine a higher ed that is capable of adaptation and change."[5]

I do believe that higher education—as well as K–12, government, nonprofit education, and corporate education—is capable of adaptation and change, particularly where mobile learning solutions are concerned. The reason for optimism is simply this: whether we like it or not, whether we are ready for it or not, mobile learning represents the next step in a long tradition of technology-mediated learning. It will feature new strategies, practices, tools, applications, and resources to realize the promise of ubiquitous, pervasive, personal, and connected learning. It responds to the on-demand learning interests of connected citizens in an information-centric world. It also connects formal educational experience (e.g., taking a class, attending a workshop, or participating in a training session) with informal, situated learning experience (e.g., receiving performance support while on the job or taking advantage of what David Metcalf has called "stolen moments for learning"[6] while riding the train or sitting in an airport waiting for a flight).

Although mobile learning certainly brings its own unique challenges, the good news is that many of the antecedents of mobile learning have prepared educational technology stakeholders for the journey ahead. With online learning—and later with e-learning—we discovered how to extend the boundaries of the institution and to reach outside the parameters of the four walls of the classroom. We also found ways to take advantage of connectivity, connections, and

A Mobile and Wireless

The mobile and wireless landscape is filled with many acronyms and new expressions. The following descriptions are provided so that nontechnical stakeholders of mobile learning can better understand the technical and industry-specific terms that are likely to be encountered. Please refer to the following Web links for more complete descriptions of the terms noted below: <http://en.wikipedia.org/wiki/>; <http://kropla.com/mobilephones.htm>; <http://www.w2forum.com>.

2G: second-generation mobile telephone technology. 2G cannot normally transfer data, such as e-mail or software, other than the digital voice call itself and other basic data such as time and date, although **SMS** messaging is available for data transmission for some standards. 2G services are frequently referred to as Personal Communications Service (PCS) in the United States. 2G technologies are either **TDMA**-based or **CDMA**-based standards, depending on the type of multiplexing used for signal exchange.

2.5G: *See* **General Packet Radio Service (GPRS).**

3G: third-generation mobile telephone technology. The services associated with 3G provide the ability to transfer both voice data (such as making a telephone call) and non-voice data (such as downloading information, exchanging e-mail, and **instant messaging**).

4G: fourth-generation mobile telephone technology. When implemented, 4G will be the successor to **3G.** It will feature high-speed mobile wireless access with a very high data transmission speed, of the same order of magnitude as a local area network connection (10 Mbits/s and up). It also addresses the notion of pervasive networks, an entirely hypothetical concept in which the user can be simultaneously connected to several wireless access technologies and can seamlessly move between them.

802.11: the official designation for the wireless protocol known as **Wi-Fi.** Short for "wireless fidelity," Wi-Fi denotes a set of wireless LAN standards developed by working group 11 of the IEEE LAN/MAN Standards Committee (IEEE 802). The term is also used to refer to the original 802.11, which is now sometimes called "802.11legacy." The 802.11 family currently includes six over-the-air standards that all use the same wireless internet protocol. 802.11b was the first widely accepted wireless networking standard, followed by 802.11a and 802.11g.

Bluetooth: an industrial specification for wireless personal area networks (see **PAN**) using radio frequencies to link enabled devices.

Code Division Multiple Access (CDMA): a rival to the **TDMA** standard in the Americas, this standard was developed by QualComm, from which providers must license its use. CDMA carriers in the United States include Sprint PCS (which started as a **GSM** carrier), Alltel, and Verizon.

Enhanced Data rates for Global Evolution (EDGE): a digital mobile phone technology that acts as a bolt-on enhancement to **2G** and **GPRS** networks. This technology operates in both **TDMA** and **GSM** networks. EDGE is a superset to **GPRS** and can function on any network with **GPRS** deployed on it (provided the carrier implements the necessary upgrades).

General Packet Radio Service (GPRS): a mobile data service available to users of **GSM** mobile phones. It is often described as "2.5G"—that is, a technology between the second generation **(2G)** and third generation **(3G)** of mobile telephony. It provides moderate-speed data transfer, high-speed "always on" data connections that are much faster than the traditional 9600 bps, by using unused **TDMA** channels in the **GSM** network.

Global Positioning System (GPS): a satellite navigation system used for determining one's precise location and providing a highly accurate time reference almost anywhere on earth. GPS is controlled by the U.S. Department of Defense and can be used by anyone, free of charge.

Global System for Mobile-telephones (GSM): the most commonly used cell phone standard in the world. GSM systems are used in nearly two hundred countries, with six hundred million subscribers worldwide. GSM originated in Europe and can now be found in Africa, Asia, Australia, and North America. Originally utilizing the 900 Mhz spectrum, GSM providers in parts of Europe, Africa, and Asia later added additional capacity at 1800 Mhz. In North America, GSM service is currently available only at 1900 Mhz. Most cell phone manufacturers offer dual-band (900 and 1900 Mhz) or tri-band (900, 1800, and 1900 Mhz) phones that will work in most places GSM systems are found.

Instant messaging (IM): a client that hooks up a user to an instant messaging service. Instant messaging differs from e-mail in that conversations happen in real time. Most services offer a "presence awareness" feature, indicating whether people on one's list of contacts are currently online and available to chat. Generally,

content-distribution capabilities to give learners alternatives for pursuing their academic ambitions via online courses and programs. Learning objects helped us consider ways that we could disaggregate the course to use content elements as components. We accepted the premise that modularity makes it easier to update outdated or inaccurate sections of a major work. We also saw great possibilities for customization and personalization of learning experiences by being able to access "just the right content, on just the right device, for just the right person, at just the right time."[7] By separating content from course, we demonstrated that the notion of flexible learning content is highly tenable *and* peer-reviewable (e.g., MERLOT, <http://www.merlot.org>). Our experiences with learning objects and with learning and content management systems have helped us to anticipate the needs for interoperability and learning technology standards, digital rights man-

Technology Lexicon

both parties in the conversation see each line of text right after it is typed (line by line), thus making it more like a telephone conversation than exchanging letters.

Integrated Dispatch Enhanced Network (iDEN): a hybrid of **TDMA** digital cell phone and two-way radio. Providers are limited (e.g., NEXTEL in the United States). Phone equipment is produced exclusively by Motorola, the company that created the standard by blending its historic experience with handheld radios with its expertise in cellular technology.

MP3: an audio compression format capable of a great reduction in the amount of data required to reproduce audio while sounding like a faithful reproduction of the original uncompressed audio to most listeners.

Multimedia Messaging System (MMS): the successor to **SMS**, this enables subscribers to compose and send messages with one or more multimedia (digital photos, audio, video) parts. Mobile phones with built-in or attached cameras, or with built-in **MP3** players, are very likely to also have an MMS messaging client—a software program that interacts with the mobile subscriber to compose, address, send, receive, and view MMS messages.

Opera: a cross-platform Internet software suite consisting of a Web browser, e-mail/news client, address book, news-feed reader, IRC chat client, and download manager. Its core layout engine is licensed by business partners Macromedia, for previewing Web pages, and Dreamweaver. Opera has gained a leading role in browsers for smartphones and PDAs with its Small Screen Rendering technology.

Personal Area Network (PAN): a network for communication among computer devices (including telephones and personal digital assistants) close to one person, where the devices may or may not belong to the person in question. The reach of a PAN is typically a few meters. PANs can be used for communication among the personal devices themselves (intrapersonal communication) or for connecting to a higher-level network and the Internet.

Personal Digital Cellular (PDC): behind **GSM** and D-AMPS, the world's mostly widely used digital system. Its use is limited to Japan.

Personal Handyphone System (PHS): a newer Japanese standard especially designed for high-speed data transmission up to 32 Kbps. Some installations may also be found in parts of China, Thailand, and Taiwan.

Radio Frequency Identification (RFID): a method of remotely storing and retrieving data. An RFID tag is a small object, such as an adhesive sticker that can be attached to or incorporated into a product. RFID tags contain antennas to enable them to receive and respond to radio-frequency queries from an RFID transceiver.

Short Message Service (SMS): available on most digital mobile phones, a service that permits the sending of short messages (also known as SMSes, text messages, messages, or simply texts or even txts) between mobile phones and other handheld devices. SMS was originally designed as part of the **GSM** digital mobile phone standard but is now available on a wide range of networks, including **3G** networks.

Smartphone: any handheld device that integrates personal information management and mobile phone capabilities in the same device. Often, this includes adding phone functions to already capable PDAs or putting "smart" capabilities, such as PDA functions, into a mobile phone. The key feature of a smartphone is that one can install additional applications to the device. Features tend to include Internet access, e-mail access, scheduling software, built-in camera, contact management, and occasionally the ability to read files in a variety of formats including Macromedia Flash and Microsoft Office applications.

Symbian: an operating system for smart phones. In an August 2004 report by In-Stat/MDR, Symbian-based smartphones were predicted to dominate over the next five years. Microsoft's CE platform is predicted to be second by 2006.

Time Division Multiple Access (TDMA): the first digital network widely used in the Americas, this system is the core of major U.S. wireless networks. The increasing growth of **GSM** and **CDMA** in the Americas is predicted to bring an end to TDMA.

Universal Mobile Telecommunications System (UMTS): one of the third-generations **(3G)** mobile phone technologies. It uses **W-CDMA** as the underlying standard. UMTS is sometimes marketed as 3GSM, emphasizing the combination of the 3G nature of the technology and the **GSM** standard, which it was designed to succeed.

Wideband Code Division Multiple Access (W-CDMA): a wideband spread-spectrum **3G** mobile telecommunications air interface allied with the **GSM** standard. W-CDMA is the technology behind **UMTS**. Networks using W-CDMA are a form of cellular network.

WiFi: See 802.11.

Worldwide Interoperability for Microwave Access (WiMAX) the domain of working group number 16 of the IEEE 802 (IEEE 802.16) that specializes in point-to-multipoint broadband wireless access. Predictions suggest that WiMAX will take over the **3G** networks and become the **4G** wireless technology.

agement, and content repositories. Learning and content management systems also underscored the critical role of support for faculty, students, and staff alike. Mobile learning will be built on the foundations of these previous educational technology frameworks and thus can take full advantage of the experiences, empirical evidence, and effective practice guidelines derived by researchers and practitioners alike from each of these preceding revolutions in education.

Lessons E-Learned

Every introductory research-design course warns us to guard against the logical fallacy of self-evident truth, and the self-evident truth of the value proposition for mobile learning is no exception to this long-established caveat. As we plan to embark on new mobile initiatives, it pays to reflect on some of the lessons learned from the early days of e-learning implementation,

back in the "good old days" of five years past.

E-learning represented one of the first viable opportunities for bringing together learning stakeholders—from the academy, from government, from the nonprofit sector, and from business—to work toward what many believed to be a "new world order" of personalized learning. Unfortunately, the earliest days of the e-learning phenomenon were a remarkable object lesson in naïveté, hubris, and missed opportunity.[8] And even though e-learning has now been acknowledged as a successful means of raising the collective consciousness about the importance of "anytime, anywhere" learning in an increasingly connected world, for many the e-learning revolution was both unsettling and unsatisfying.[9]

If mobile learning really does represent the next stage in an ongoing continuum of technology mediation, the following "lessons e-learned" need to be kept in mind:

- *Learning is a deeply personal act that is facilitated when learning experiences are relevant, reliable, and engaging.* During those early days of e-learning, we learned the hard way that simply building a learning system that could be accessed over the Internet did not guarantee that people would have much need for or interest in the courses and programs being hawked—by institutional and commercial provider alike. We learned that shoveling courseware online did not provide anyone—faculty, students, or administrators—with an online experience that was much more than tedious electronic page-turning. Sometimes we learned the hard way that "doing learning unto others" could quickly demotivate and disengage the very people we had hoped to serve.
- *Different kinds of learning demand appropriate strategies, tools, and resources.* Concrete operational learning can be facilitated using representational media, whereas teaching complex problem-solving—such as performing surgery or landing an airplane—may be far better served by allowing learners to practice developing those skills in a safe, risk-free virtual environment. Having just-in-time access to information, even in a flat-file text-based form, may be far preferable to having no access to any information at all. Questions about media-appropriateness from a pure cognitive perspective are likely to be mitigated by aesthetic and experience quality metrics. More than twenty years of empirical evidence underscore that there is no such thing as a "one size fits all" technology solution for learning.[10]
- *Technology in and of itself may not guarantee better learning.* But when effectively deployed, technology can help focus attention while attracting and maintaining a learner's interest. Technology can engage learners by structuring and organizing information, by displaying and demonstrating procedures and operations. It can help make a learning experience more

memorable and can help relate new information to that which is already known. Technology can simulate a range of conditions, immerse people in virtual environments, and provide safe practice opportunities as mastery is developed—all of which are necessary conditions for maximizing the probability that learning will occur. Perhaps even more important, technology allows us to have relationships with information in our own, unique ways. This phenomenon effectively shifts the question from "Will technology improve learning?" to "How much further will technology let us push the envelope of human cognitive, affective, and kinesthetic experience?"

- *The better the experience and the more intentional the results, the greater is the likelihood that learning will occur.* In reflecting on the importance of experience design in software development, Kevin Mullet has noted that early software users were themselves programmers and consequently were highly tolerant of complex interactive models and primitive visual displays.[11] Today's users are very different. Interactive software is now considered useful only to the extent that ordinary users can understand and take advantage of the functionality it provides. Looking at it from a learning-oriented perspective, when technology can help strengthen learner motivation, focus attention, make a learning moment more memorable, or demonstrate the relevancy of learning to performance, the greater is the likelihood that technology will have a direct positive effect on learning. To this end, one exciting possibility of the coming mobile movement is an opportunity for a sharper focus from instructional technology and instructional design programs on the value of experience design for learning.

What Makes Mobile Viable Today?

As we consider the future of mobile learning in the United States, it is useful to take a look at the variables that are the catalysts for change. Three converging phenomena are accelerating today's mobile-adoption curve.

First, there are more wireless networks, services, and devices than ever before. Today's wireless communications industry is in global growth mode. According to the *Telecommunications Market Review and Forecast,* published by the Telecommunications Industry Association (TIA), total U.S. spending on wireless communications will grow 9.3 percent in 2005, to $158.6 billion. The report predicts that the wireless market will grow at a 10 percent compound annual growth rate through 2008, reaching $212.5 billion. Revenue in 2004 totaled $145.1 billion, up 11.6 percent from 2003.[12] Yet even with the steady expansion of wireless networks and services, mobile experiences in the United States lag behind the connectivity options available in other countries. For example, in South Korea, acknowledged by many as the most connected country in the world, citizens

are far more likely to have broadband Internet access in the home. They are also more likely to carry a mobile phone with broadband access, enabling rich mobile services. A recent *San Francisco Chronicle* article noted that about 76 percent of households have broadband access in South Korea, compared with 30 percent in the United States. Similarly, approximately 75 percent of South Koreans have a mobile phone, whereas only 60 percent of Americans have a mobile phone.[13] The statistics from China's Ministry of Information Industry (MII) show that total phone users in that country reached 647,267 million last year, comprising 334.8 million mobile users and 312.4 million wireline users. Also according to the MII, in 2004 China had 114,567 million new phone subscribers, 64,871 million of them being mobile phone subscribers and 49,696 million fixed phone subscribers. One interesting statistic notes that Chinese mobile phone users sent 217.76 billion short messages in 2004, up 58.8 percent from the previous year.[14]

Eilif Trondsen recently described the mobile landscape as a connected framework of wireless networks.[15] Some, notably Bluetooth, are typically used for creating a personal area network (e.g., linking a wireless earpiece to a mobile phone worn on the belt). Wireless fidelity (WiFi) networks are described as local area networks, the kind of network typically found in the home or office. Cellular technologies inhabit the domain described as either a metropolitan area network or a wide area network and are designed to cover broad geographic regions. Telephone consumers all over the world are showing increasing interest in new 3G higher-speed mobile phones based on the W-CDMA (Wideband Code Division Multiple Access) standard. At the start of 2005, more than 16 million people worldwide owned 3G phones, based on the W-CDMA standard. The UTMS Forum had previously counted approximately 10 million handsets sold as of September 2004. W-CDMA is the fastest-growing successor to the second-generation GSM standard.[16]

Second, consumers are demanding better mobile experiences than ever before. In reflecting on what makes an experience great, Kevin Mullet has noted that other things being equal, we want our experiences to be as vivid—as immediate, direct, and engaging to our senses—as possible.[17] Experience depends on our own presence as events unfold. The closer we are to the action—or, if not physically present, the closer we seem to be based on the qualities of the medium through which we follow the action—the more authentic the experience will seem. Usability is more elusive. Software tools need to be usable without too much incremental effort. What is the point of automation if it takes more work to do the job with the software than without it? In the often hands-free and eyes-free environments where mobile learning is most appropriate for just-in-time learning support, complicated key controls and difficult-to-read screen presentations will be tolerated only under certain very limited

conditions. The rest of us aren't willing to risk having a bad experience. For broad and long-term adoption, the experience really does matter.

A rich mobile Internet experience includes the following attributes:

- *Ubiquity:* How widely available is the media player that will be required for the viewer to see the application on the device display?
- *Access:* How widely available is the wireless network that will distribute the mobile content?
- *Richness:* Do pages load quickly? Do animations play in a smooth and seamless manner? Does the streaming media (media that is consumed—read, heard, viewed—while it is being delivered) flow at a sufficiently rapid rate?
- *Efficiency:* How large is the client that will be required to make use of a particular media player? How fast will the application load and play?
- *Flexibility:* Will the application be viewable on a variety of devices? Can content designed for use with one kind of device or operating system be played on other devices with some expectation of comparable quality?
- *Security:* Is the interactive mobile device protected from worms and viruses? Is the shared content protected from being intercepted by unintended recipients?
- *Reliability:* Will content be displayed in a consistent manner, regardless of the browser, device, and screen size?
- *Interactivity:* Does the application allow users to interact freely with the display and the content?

Third, people want "anytime, anywhere" connections more than ever before. Demands for information, performance support, instruction, training, and education are being shaped by people who want access to resources, assets, program, and people when and where they need those connections most. As more people gain greater comfort with simple mobile applications like SMS text-messaging and mobile Web-surfing, the greater will be the demand for broadband service. And as bandwidth increases and media players like Flash continue to improve users' experiences, the more rapidly will mobile applications continue to increase in number.

Current Mobile Trends in Education

Although tablets and laptops have provided the means and the methods for demonstrating that learning no longer needs to be classroom- or course-bound, the anticipated rush toward mobile learning will be sparked by the obvious draw of short, stand-alone programs. Current trends suggest that the following three areas are likely to lead the mobile movement: educational games, language instruction, and performance-support and decision-support tools. In particular, gaming has taken the wireless world by storm, and there is every reason to believe that educational gaming will provide mobile learning with its first big "win," in

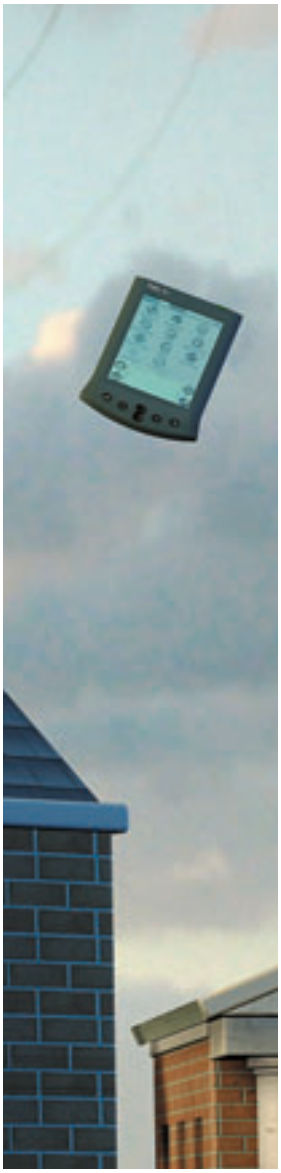
terms of adoption. In a March 8, 2005, talk given at the Game Developers Conference (GDC) held in San Francisco, Robert Tercek, co-chairman of GDC Mobile, said that 6 million people download games to their mobile devices each month and that 18 million Americans play wireless games. He added that worldwide, there are 170 million wireless gamers.[18] This broad fascination with mobile gaming is mirrored in a growing interest in higher education developments in interactive game design curriculum, such as the program at Southern Methodist University.

Mobile learning offers many rich opportunities for personalizing learning experiences: broad, comprehensive community wireless initiatives such as OneCleveland; rich field-based experiences such as those found at California State University–Monterey Bay; immersive museum-enrichment experiences such as the Blanton Museum at the University of Texas–Austin; and campus-wide laptop initiatives such as at Winona State University. Increasingly, mobile learning will feature rich, dynamic portal applications such as those available to students attending the Wharton Business School at the University of Pennsylvania.

The Future Mobile Landscape

Will 2005 stand out as the year when mobile learning takes off in the United States? Will mobile learning deliver on the elusive promise of better learning through technology? In his discussions of the impact of disruptive technologies, Clayton Christiansen noted that innovations, though initially not as reliable as the tool or practice they supplant, do bring about significant change when they are finally adopted on a broad scale.[19] In describing the possible changes that mobile technologies are likely to introduce in teaching, learning, and research practice, Penny Wilson has described mobile wireless devices—such as cell phones, handhelds, and notebook computers—as "tools of mass disruption" that are going to help spark a period of innovation for learning technology stakeholders of all kinds.[20] The success of mobile learning will ultimately revolve around a mosaic of rich converged experiences. These experiences will rest, in turn, on a foundation of converged network and device technologies, wireless services, rights management, content management, search management, and transactional processing power. Successful mobile learning will demand a rich presentation layer that runs efficiently on a variety of platforms and a variety of form factors. Effective mobile learning programs will require new digital communication skills, new pedagogies, and new practices. Luckily, as we anticipate the arrival of 3G and 4G technologies, we have time to prepare for the oncoming wave of learning innovation.

Successful mobile learning will demand a rich presentation layer that runs efficiently on a variety of platforms and a variety of form factors.



Notes

1. "Mobile Touches All Facets of Life" (excerpt from *The Economist*), *San Francisco Chronicle*, March 15, 2005, B7.
2. Robby Robson, personal communication with the author, January 21, 2005.
3. Kenneth Green, *The 2004 Campus Computing Project*, <http://www.campuscomputing.net>.
4. Bryan Alexander, "M-Learning: Emerging Pedagogical and Campus Issues in the Mobile Learning Environment," *EDUCAUSE Center for Applied Research (ECAR) Bulletin*, vol. 2004, no. 16 (August 2004), a publication of ECAR (http://www.educause.edu/ecar). See also Bryan Alexander, "Going Nomadic: Mobile Learning in Higher Education," *EDUCAUSE Review*, vol. 39, no. 5 (September/October 2004): 28–35, <http://www.educause.edu/pub/er/erm04/erm0451.asp>.
5. Ellen D. Wagner and Robby Robson, "Education Unplugged: Mobile Learning Comes of Age," presentation at the Annual Meeting of the National Learning Infrastructure Initiative, New Orleans, Louisiana, January 24, 2005; Colleen Carmean, blog entry, January 24, 2005, <http://blog.educause.edu/carmean>.
6. David Metcalf, "Stolen Moments for Learning," *eLearning Developers' Journal*, March 2002.
7. Wayne Hodgins, "The Future of Learning Objects," presentation at the Learning Objects Forum, Menlo Park, California, September 3, 2002.
8. Ellen D. Wagner, "Will Learning Survive Our Good Intentions?," in *Transforming Culture: An Executive Briefing on the Power of Learning* (Charlottesville, Va.: Batten Institute at the Darden Graduate School of Business Administration, University of Virginia, 2002), 47–52.
9. Robert Zemsky and William F. Massy, *Thwarted Innovation: What Happened to eLearning and Why* (Philadelphia, Pa.: University of Pennsylvania, Learning Alliance for Higher Education, 2004).
10. For example, see Richard E. Clark, "Reconsidering Research on Learning from Media," *Review of Educational Research*, vol. 53, no. 4 (1983): 445–60.
11. Kevin Mullet, "The Essence of Effective Rich Internet Applications," Macromedia White Paper, November 2003.
12. Telecommunications Industry Association, *2005 Telecommunications Market Review and Forecast*, <http://www.tiaonline.org/media/mrf/>.
13. "Waiting on Mobile," *San Francisco Chronicle*, March 15, 2005, C1.
14. "Cellphone Users Send 217.7 bn SMS in 2004," *China Daily*, January 20, 2005, <http://www.chinadaily.com.cn/english/doc/2005-01/20/content_410864.htm>.
15. Eilif Trondsen, "Global Perspective on mLearning," presentation at the Macromedia Higher Education Leadership Forum, San Francisco, California, February 24, 2005, <http://www.sric-bi.com/news/ETrondsen-mLearning2005-02.pdf>.
16. John Blau, "WCDMA Has More Than 16 Million Users Worldwide," *Infoworld*, January 6, 2005, <http://www.infoworld.com/article/05/01/06/HNwcdmausers_1.html>.
17. Mullet, "Effective Rich Internet Applications."
18. Robert Tercek, welcoming remarks, Game Developers Conference, San Francisco, California, March 8, 2005.
19. Clayton M. Christiansen, *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail* (Cambridge: Harvard Business School Press, 1997).
20. Penny Wilson, "Where Macromedia Education Is Headed," presentation at the Macromedia Higher Education Leadership Forum, San Francisco, California, February 24, 2005.