INTRODUCTION

Web-based training (WBT) is learning at a distance using online training methods and delivery technologies. WBT is a subset of distance education, providing current content, adaptable and flexible access, and collaboration and interaction opportunities with other learners, tutors, and knowledge sources, potentially worldwide. Mobile learning (or m-learning), the use of portable computing and communications devices, and pervasive computing, in which all aspects of a job or work environment are interconnected, are outgrowths of WBT (Leiner et al. 2002; Mobile learning 2004). WBT is grounded in the proven capacity of well-designed and well-moderated computer-mediated communications (CMC) to create and sustain effective collaborative and cooperative learning environments at a distance (Fullord and Zhang 1993; Rose 2004; Gigucu, Formica, and Harding 2004).

Another key to WBT is the World Wide Web (www). The Web was at least occasionally available to 45 percent of the world’s population in 2003 (OECD 2005), and in 2006 over a billion people were regarded as “Internet users” (Internet usage statistics 2006). The “digital divide” (between technology haves and have-nots) was even disappearing, according to some observers, early in the twenty-first century (Rupley 2005; Cheap tricks 2005).

The story of WBT is not without its ups and downs, however. the Web as a training tool has had both spectacular successes and disasters. While institutions such as the University of Phoenix, Concord Law School, the University of Monerey, and Canada’s Athabasca University were successfully using online methods to offer courses throughout North and Latin America and Mexico, others (Columbia, Wharton School, Temple University, and NYU) were experiencing expensive failures with WBT (Higher Education Inc. 2005).

The theme of this chapter is that, as a training tool, the Web is potentially powerful, providing access to flexible, timely, relevant, and interpersonally satisfying collaborative training opportunities, including superior content learning and a sense of membership in an online community (Hiltz, Johnson, and Rabke 1980; Revai and Barnum 2003; Fahy 2004; Conrad 2005). Wherever flexible training and professional development (PD) are central to organizations or nations, WBT can offer access to upgrading, training, retraining, and varied lifelong learning opportunities. Accompanying WBT’s strengths, however, are potential challenges or outright shortcomings (Dede 1996; Barns’ storming 2005).

Potential advantages of WBT include:

- WBT is available anywhere and anytime, reducing time and travel-subsistence costs, and increasing learner control (Kaye 1999; Wagner 1994; Bates 1995; Harapniak, Monogomeric, and Torgerson 1996; Revai and Barnum 2003; Don’t take my PC 2004).
- Skillful e-moderating and instructing strategies can produce an interpersonal experience equal, or even superior, to face-to-face learning, especially when traditional courses are crowded or instructors overworked (Walther 1996).
- Centrally stored materials can be continually and immediately revised and updated, ensuring accuracy and currency.
- Use of markup languages (HTML, XML, SGML), and other interoperability provisions that are part of the Web’s history of openness, ensure cross-platform compatibility.

Challenges of WBT include:

- Training materials must be carefully designed, or redesigned, for Web delivery; a sometimes substantial initial investment may have to be made in equipment and training (including potentially costly content management systems [CMSs] and learning management systems [LMSs]); and trainees and instructors may have to learn new technical (and teaching-learning) skills (Welsch 2002).
- Structure must be provided in the learning environment to prevent users from wasting time, or straying into misinformation (Warren et al. 1996). The concept of e-moderating, the use of online methods for assessing and responding to trainees’ needs for guidance, feedback, motivation, and human contact, arises from the fact that users do not always or automatically use WBT technologies skillfully or willingly.
- Bandwidth and technical limitations may restrict or even prohibit access to some Web resources.
- Dropout rates may be a problem in WBT, if users’ problems are not monitored and addressed.
In this chapter, the history, characteristics, potentials, and challenges of WBT will be reviewed. Included will be a discussion of some important underlying general training principles critical to the evolution of WBT, the Web's strengths and limitations for delivering learning opportunities, features (and limitations) of some of the technologies WBT draws upon, and future prospects of WBT.

FUNDAMENTAL TRAINING PRINCIPLES AND WBT

In the first half of the twentieth century, the pioneering work of researchers such as Thorndike (1911), Dewey (1938), Skinner (1971), and Keller (1968) led to the articulation of fundamental learning principles. (These individuals researched and wrote in the fields of psychology and education, but their theories have been incorporated into the design of effective teaching of all kinds, including WBT.)

Thorndike's three fundamental behavioral laws, now common in WBT, were among the first to be stated: (1) repetition strengthens new behaviors; (2) reward associated with a particular behavior increases the likelihood it will be repeated, while punishment or lack of reward diminishes the likelihood of recurrence; and (3) individuals often differ in their personal readiness to perform a new skill or behavior (Saeltzer 1990).

Dewey added that individual trainee differences were crucial in the success of training. He and Piaget (1952) both recognized the importance of each individual learner's personal background, and advocated that trainees' experiences and previous learning be considered carefully and accommodated as much as possible in any new training situation.

Skinner applied and extended behavioral principles, with the "teaching machines" movement of the 1950s and 1960s. In behavioral psychology, the trainer was "the manager of the contingencies of reinforcement" in the learning process. Besides describing the instructor's role in a new way, Skinner's work illustrated points vital to the subsequent development of technology-based training, including the value of "the program over the hardware," and the critical importance of the learning materials and the organization of the learning environment (Saeltzer 1990).

Keller's Individually Programmed Instruction (IPI) model applied Skinner's discoveries about the importance of instructional design. The IPI model (called the "Keller Plan") emphasized individual differences in instruction and evaluation, including principles, later core to WBT, such as self-paced, mastery before advancement, high-quality materials, tutoring help, prompt feedback, and careful and frequent evaluation, including practice testing (Fox 2002). Experiments such as teaching Morse code to World War II recruits demonstrated convincingly that these principles could dramatically increase the efficiency of procedural and skill training.

Innovations such as IPI were impressive, but they encountered organizational resistance for several significant reasons that are relevant to WBT:

- As innovations, technology-based training models often make new demands on institutions, trainers, and trainees. In particular, technology-based training delivery increases the responsibility of trainees for their own learning, while limiting instructors' "platform" opportunities, serious flaws in the eyes of some trainers (and some trainees).
- Evaluations of technological innovations may initially yield "no significant difference" findings (www.nosignificantdifference.org); time may be needed to reveal their true value.
- Trepid managerial support may doom a technological innovation, especially if time and resources to prove its actual potential are in any way lacking.
- Individualized training models usually require more advance planning and preparation, while (at least initially) increasing workloads on instructors and administrators, and resource demands on programs, and while sometimes destabilizing programs during the adjustment phase.
- When granted responsibility for managing their own learning, some trainees may respond with demands for more individual treatment, including remedial and accelerated options. Overall, in individualized programs, including WBT, trainees expect their individual performance, needs, and preferences to be acknowledged and better met than in typical in face-to-face group training.

In the 1960s and 1970s, continued developments in instructional design, emerging consensus about "best practices" in adult learning, advances in cognitive and behavioral psychology, and new tools and approaches for the design and delivery of training converged to impact the emerging field of technology-based training and WBT. Other figures whose work influenced the evolution of technology-based training include Mager (1975), Suppes (1978), Glaser (1978), Gagne and Briggs (1979), Briggs and Wager (1981), and Dick and Carey (1978).

ASPECTS OF THE WEB AS A TRAINING TOOL

WBT's Payoffs and Demands

The Web emerged as a potentially powerful training tool, as training was transformed by new understandings of learning itself, and appreciation increased of the needs of trainees and training organizations (Biesenthal-Lucas 2004; Birk-Aghaai and Simoff 2004; Burbules and Callister 1998; Garrison, Anderson, and Archer 2000). Users responded to the Web's training potential differently, at least in part according to their appreciation of the importance of skill-training. Table 1 shows the range of possible engagement in training, from initial awareness to maintenance of a systematic training effort.

The potential of WBT to address critical training needs comes with costs, in the form of challenges to instructors and learners: different roles and responsibilities, changes in teaching methods and the learning environment, emphasis on individual differences, new financial and economic realities, and unprecedented security requirements.
Table 1: Employer Training Engagement Continuum

<table>
<thead>
<tr>
<th>Stage 1</th>
<th>Stage 2</th>
<th>Stage 3</th>
<th>Stage 4</th>
<th>Stage 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gaining awareness of the general importance of skills</td>
<td>Recognizing and understanding the significance to their own organization</td>
<td>Making choices—to act or not to act?</td>
<td>Taking action— involving Sector Councils</td>
<td>Maintaining or increasing the training effort</td>
</tr>
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New Roles, Practices, Tools

Web-based training creates changes in the ways trainees interact with the trainer, the content, each other, and the learning system (Moore 1989). Because WBT allows shifting of place and pace of learning, roles change; the focus is on the trainees’ skill development, and the tutor or trainer consequently becomes less the “sage on the stage” and more a “guide on the side” (Burge and Roberts 1993). Similarly, if permitted, equipped, and disposed to do so, trainees may assume more responsibility for their own learning, including accessing outside materials, communicating freely with the trainer, and collaborating with other trainees. Overall, successful WBT programs change trainees’ experiences, providing greater individualization; making feasible self-spacing, on-demand review, acceleration, and practice testing; and providing ready linkages to a range of people and resources (Mollnari 2004).

Because of the differences between online and traditional delivery, trainers in Web-based environments may find their duties and priorities changed. A study by the National Education Association (2000) of U.S. college instructors in a variety of institutions found that:

- Most reported WBT was more personally rewarding than traditional methods; distance methods were seen as giving trainees better access to information, better-quality materials, more help in mastering the subject matter, and more allowance for individual needs.
- Most instructors had at least some one-on-one contact with their Web-based learners, and those who had such contact reported higher levels of satisfaction.
- WBT required more instructor time, which, unfortunately, most training organizations did not formally recognize.
- Despite lack of organizational recognition of the greater time required, almost three-quarters of the survey respondents held positive feelings about distance teaching (14 percent reported negative feelings).

Materials and Instructional Activities

In traditional face-to-face teaching, instructional materials may be prepared at the last minute, or even simply dispensed with (trainees being required to take notes from the comments and chalkboard musings of the instructor). In WBT, materials preparation is a major stage in program development. Complete WBT materials are self-contained, including organizers and instructions, with guidance and feedback provided through embedded questions and other self-evaluation activities, and computer-mediated communications (CMC) with the instructor and other learners. Support and orientation are provided for the technologies used.

In well-designed and well-managed WBT, instructional activities and materials may use some or all of the following principles:

- Typically, a wider range of resources, some from outside the local environment (accessed via the Web)
- Experiential learning and simulations
- Collaboration replacing competition (Collins and Berge 1996).
- Problem- or case-based learning, increasing training’s realism and authenticity (students are permitted, even urged, to refine questions and objectives themselves, without constant reliance on the trainer) (Berge 1995).
- Personal knowledge and experience valued and included in problem-solving activities (Newby et al. 2000).

Multimedia are sometimes used to enhance WBT experiences; the impact of multimedia ultimately depends on recognition of certain design principles that govern their impact (Mayer 2001). These principles underscore the importance of systematic design and monitoring of WBT. Failure to produce instructional materials based on sound learning principles results in, among other errors, the amateurish use of effects for their own sake (contemptuously called “dancing baloney” by Web professionals) (HIP 2000, 2001). Failure to monitor learners’ responses results in greater transactional distance in the learning environment (Moore 1991), potentially leading to alienation and, in the worst cases, dropout (Frankola 2001).

New tools, such as blogs and podcasting, allow instructors and trainees to develop and “broadcast” (via Internet RSS (feeds) audio programs on any subject, downloadable to portable devices (Pods) or PCs. These are examples of how technologies offer new possibilities for delivery of training, and, because of their ready availability, make sound instructional design in serious training programs even more important (Magid 2005, DIY).

“Best” Instructional Practices in WBT

Well-designed WBT incorporates specific strategies known to enhance learning. One training model recommends that trainers strive for a balance between interpersonal rapport and intellectual excitement, requiring the trainer to be interpersonally warm, open, reliable, and
learner-centered, while also being clear and enthusiastic about the training content (Lowman 1994).

Another well-respected model suggests the following best instructional practices, applicable to WBT (Chickering and Gamson 1989):

- Encourage contacts between trainees and instructors.
- Develop reciprocity and cooperation among trainees.
- Use active learning techniques.
- Give proper and timely feedback.
- Emphasize time-on-task.
- Communicate high expectations.
- Respect diverse talents and ways of learning.

Bloom's (1984) classic description of the “alterable variables” of learning also provides guidance for Web-based developers and trainers. Research in mastery learning showed that the following principles, when emphasized, produced learning outcomes similar to what could be achieved under ideal training conditions (defined as one-to-one tutorials):

- Provide well-designed tutorial instruction.
- Give timely reinforcement.
- Give appropriate and sensitive corrective feedback.
- Provide cues and explanations, as needed.
- Encourage learner participation.
- Assure trainees make effective use of time on task.
- Help trainees improve reading and study skills, as required.

In general, adult education pedagogical principles of relevance, immediacy, learner control, autonomy, self-direction, self-pacing, and individualization are core to WBT practice (Kidd 1973; Knowles 1978; Cross 1981). One of the major differences between Web-based and more traditional forms of training is WBT’s capacity for accommodating the individual expectations and preferences of trainees. This feature can be particularly valuable in meeting diagnosed “special” needs, or needs based on adult trainees’ personal and situational variables. Personal variables include age, maturity, personal health, time availability (and management skills), motivation, previous learning, financial circumstances, and life and developmental stages. Situational variables include location (related to the location of any required site-based training), admission and training program requirements, availability of counseling and advisement services, and personal issues such as transportation, health, and childcare (Cross 1981).

WBT’s capacity to accommodate differences effectively partially depends on the trainees’ capacity and willingness to exercise independence, autonomy, and self-direction. Even if trainees are mature adults, the presence of the needed skills and confidence for self-directed learning cannot always be assumed. Trainees must be able and willing to exercise self-direction and independence in learning.

The needs analysis component of the design process is particularly critical, as problems can arise in WBT situations when there is a mismatch between the self-direction the learning system permits or requires and the expectations of the trainees. As previously noted, mismatches between teaching or training style and learning style can result in dissatisfaction with the learning experience, or worse (alienation, failure, dropout). Programs are more successful if aligned with the developmental stages of individual learners. Trainee readiness may range from nearly complete dependency to autonomous self-direction, requiring the trainer to function variously as an authority or coach, a motivator or guide, a facilitator or mentor, and, at the highest levels of self-direction, a consultant (Grow 1991). Failure to provide learning conditions compatible with trainees’ expectations for support, interaction, or recognition may be one of the principal reasons for unacceptably high dropout rates in some WBT programs (Frankola 2001).

Economic Factors

The economics of WBT, though changing rapidly in the details, continue to directly impact training providers and consumers.

For Providers

Skills requirements continue to increase, motivating employers to retain proven employees with the potential to grow with the expectations of their jobs (see Figure 1). While the economic argument for training is strong, costs of development of WBT can be considerable, and vary dramatically. Primarily text-based WBT, involving conversion of existing materials using one of the many available authoring tools, may be economically accomplished by a subject-matter expert (SME) possessing basic instructional design skills. On the other hand, development of 1 hour of computer-assisted learning (CAL) using high-level authoring languages might require up to 150 hours of design and programming (Szabo 1998). Financial considerations are primary in most WBT implementations: if an organization cannot afford the attendant costs (especially the often heavy initial investment in development), it may not be able to make the transition to WBT, even if the need is clear and the organization willing (Welsch 2002). Bates (2000) argues cogently that costs and accessibility are the two governing criteria in the successful adoption of technology; the same could reasonably be argued for WBT.

WBT must be promoted realistically, without overselling its possible benefits or impacts. Although WBT offers the potential for substantial increases in convenience and improvements in efficiency (including reduced training costs), it is important to acknowledge that results of WBT cannot be guaranteed to be better for all users. This is because of interactions among economic, technical, personal, organizational, and environmental factors. One of the paradoxes of the past decade’s use of technology generally, including training applications, has been the persistent finding of “no significant difference” in training results, accompanied by the “productivity paradox,” the failure of some industries to achieve economic benefits from technology implementations, while others made impressive performance gains (Faby 1998). Nevertheless, when design converges advantageously with needs,
opportunities, and a willing corporate culture, WBT has proven both successful and cost-effective (Welsh 2002).

**For Trainees**
Just as employers have seen the value of trained and skilled employees increase, employees are also aware that their prospects are directly related to their skills, as shown in Figure 2.

As they have become increasingly aware of the need for personal skill training, employees have also come to expect that the workplace will provide timely, economical, high-quality, self-paced training, virtually anytime and anywhere (Vaas 2001). The keys to meeting these expectations are the cost and accessibility of the WBT technologies used (Bates 2000), and the relevance of WBT's interaction capabilities with respect to specific training applications (Fischer 1997; Inculcating culture 2006).

For trainees with "special" learning needs, WBT's interaction capabilities can provide important advantages. The mobility-handicapped, and those with learning disabilities, often find an environment with more learner...
controls, typical of WBT, helpful (Keller 1999). Two core features of WBT directly applicable to special-needs trainees include:

- Structure, including advance organizers; clearly stated objectives, schedules, and timelines; embedded comprehension checks; integrated media under learner control; multimodal presentations; user-accessible performance records and reports; and communication links with the trainer and other support resources.
- Flexibility—any place, any pace access.

Trainers working with special-needs audiences must have enhanced capabilities to monitor progress, including easy communications with other helpers and supports. Trainees without special needs can also benefit from features of WBT, as these can potentially increase satisfaction and lower stress in general by reducing potential conflicts between the demands of training and participants’ careers and personal lives. WBT’s emphasis on interaction may help address:

- Feelings of inadequacy at the sheer amount of material to be covered.
- Delays in receiving feedback or answers to questions.
- Keeping up with the variety of discussions and interaction often present in online (computer-mediated communications, or CMC) discussions.
- Adjusting to the absence of visual cues in group relations.
- Fatigue and health problems arising from reliance on unfamiliar technologies (eye strain or posture problems at the computer, for example).

Security Issues
System and Personal Security
Security is a critical element of Web-based systems in general, and of training systems in particular, especially wireless systems. By one estimate, malware of all kinds caused $55 billion in losses to Web users in 2003. Since 2003, damaging and hard-to-detect worms and Trojan horses have become the most common forms of malicious code. The threat is increasing; the virus-to-e-mail ratio was expected to go from 1 in 700 in 2000, to 1 in 2 by 2013; spyware has also become more prevalent and potentially damaging (Outbreak 2001; Airborne outbreak 2005).

In addition to protecting itself, a WBT training technology must also provide security for its users. Confirming and safeguarding the identities of trainees is a special problem in WBT, especially if they do not routinely meet face to face with instructors. Just as failure of a security system might expose a training organization to embarrassment, expensive down time, or even litigation, failure of an organization’s screening and monitoring systems leading to a fraudulent registration, award of credit, or granting of a credential might be disastrous for its reputation. Biometric and other devices may make checking identities of trainees, supervising remote testing events, and blocking spyware (thus protecting the records and identities of participants) more practical and economical (Bader 2005; Talbot 2006).

PRESENT AND FUTURE PROSPECTS OF WBT
While WBT has proven its potential value for training delivery, some barriers continue to restrict or slow its expansion and impact its uses in complex training environments. These barriers arise chiefly in relation to bandwidth availability, user access to and adoption of required technologies (especially for m-learning), and user activity (especially unproductive and addictive behavior). Major opportunities lie in mobile learning and pervasive computing.

Bandwidth and Access
Broadband
Today, most North American Internet users have broadband access, from home or work, though broadband is more accessible in many European and Asian countries than in North America (Free speech and witch hunts 2005; Internet usage statistics 2006). Comparisons can be complicated by the fact that technologies with the same name sometimes have different performance characteristics: ADSL (asymmetric digital subscriber line) in Korea, for example, delivers 20 Mbps, while in Japan the rate is 26 Mbps, and in Switzerland it can be as low as 500 to 700 Kbps (Broadband 2004).

One of the implications for WBT of the increasing ubiquity of broadband is the increasing availability and lower cost of the accompanying technologies, including broadband-based TV (IPTV), and voice over Internet protocol (VoIP; voice only, or voice plus video). IPTV competes with satellite and cable versions in functionality, at considerably lower cost (Telecom broadcasting 2005).

Voice over Internet Protocol
VoIP permits the use of computers for voice and limited video communications, either as two-way private conversations or in multipoint group (class) sessions. While broadband is helpful, voice-only users may require no more than dial-up access to the Web, plus a sound card, microphone, and speakers. For voice and video, VoIP typically provides a small video display, with a refresh rate governed by bandwidth. (IP video is currently not of full-motion quality; its jerkiness and grainy nature lead some users to switch it off completely, relying on audio alone.) The quality of IP audio is usually good to very good. VoIP services are cheap, and may even be free for small numbers of users. Technical advancements, the low cost of VoIP, and growing experience suggest that this technology has a bright future in WBT situations, offering immediate advantages for interaction and support (Miller 2004; Dvorak 2005, The coming death of cheap VoIP, 2005, Inside track).

Wireless Systems
The cost of installing short-range “fixed” wireless systems in buildings or campuses is less than the cost of wiring
(or rewiring). Besides cost savings, wireless technologies install more quickly and are highly portable. Wi-Fi for small areas, and Wi-Max for areas up to 30 miles from the broadcast point, with transfer speeds of up to 15 Mbps, are available (Roush 2004; Huitson 2005; Fast tracked 2005; Why wait? 2005; Otain 2005). Wi-Max also offers a mobile capability, permitting reliable digital mobile TV transmission to handheld devices and PCs (Ellison 2005). The costs of other types of wireless technologies with wider coverage areas, such as cell phones and IM (instant messaging), are also dropping, and their reliability is increasing (Grimes 2003; Garfinkel 2004; Rupley 2004). All of these technologies have potential impacts on WBT, and some have already been tried successfully (www.wirelessdevnet.com).

Satellites provide a powerful, though more costly, alternative to ground-based data transmission for widespread, large-scale WBT systems. All the usual production costs apply to satellite-based delivery, costs may in fact be higher; since the greater potential audience warrants higher production values. In addition to the costs of developing and launching the satellite, the impact of equipment failures is significant, given the inconvenience of service calls.

Despite a downward trend in cost, wireless systems for WBT have some major disadvantages: even when transmission speeds are not slower than wired broadband (they often are), interference may lead to transmission errors, reducing effective speed (a problem exacerbated by the presence of other electronics); range depends on the site layout and configuration of the network (including building characteristics and materials); and wireless systems are more vulnerable to security threats.

Unproductive Internet Use and Addictive Behavior
Technology in general does not automatically increase productivity; in fact, there is evidence that it may even decrease productivity, especially in the short-term, while systems and people adjust to its presence (Fahy 1998; Dalal 2001). More serious problems arise from users' behavior, especially unauthorized use of technologies during work hours, and addiction. Both have implications for the productivity of WBT, especially where trainees are at a distance or are otherwise minimally supervised.

Huge amounts of time can be wasted online. In 2003, a study found that employees spent an average of 4.5 hours per week on the Internet at work for "personal reasons," leading 57 percent of employers to adopt policies defining legitimate Internet use (up from 33 percent in 2000) (Employees spend 2003). A more recent study found that half of employees surveyed spent from 1 to 5 hours online daily for personal reasons, most commonly reading the news, but also on travel, personal e-mail, shopping, and financial tasks (Punching out 2004). The problem is not new: some time ago, the U.S. Treasury Department noted that 40 percent of the inquiries it received came from workplaces, and e-Bay is one of the most often accessed Web sites from workplace locations. The problem is exacerbated by the fact that employees often do not perceive a problem with this use of their time and company resources: only one in ten employees in one survey felt using the Web for non-work reasons was unethical (Workers find 2001).

In addition to the potential for lost time (and drain on network resources) constituted by time spent online but off-task, some Web users become addicted to the technologies. For example, though only about one in four business e-mails actually requires immediate attention, one study found that substantial numbers of employees (34 percent) check their e-mail continually during the day, 42 percent check their business e-mail while on vacation, and 23 percent check it on weekends (E-mail addiction 2001), behavior that, if indicative of compulsive or addictive tendencies, requires WBT instructors' vigilance (Whittaker 2005; Breeding evil? 2005).

The above reinforces the point made previously that management of WBT requires attention to structure (to minimize intrusion of distractions) and dialogue (to discuss use of training time) (Moore 1991).

The Evolution of Media
Training media are changing as bandwidth improves, and as they do new technologies are presenting WBT designers with options and capabilities that were previously unavailable or uneconomical. Examples include the previously mentioned VoIP and new portable presentation technologies, updated from the Web but used offline, and possessing high portability and vast storage capabilities.

Improvements in Storage and Portability of Information
For cheap, high-capacity storage, the CD has been replaced by the DVD. Blue-laser technology, though currently without a common standard, promises vastly greater storage (23 to 27 GB of storage currently demonstrated, with 50 GB promised), for both video and audio (Labriola 2004; Dvorak 2005; HD DVD).

Storage devices have also gotten much smaller, and capacities have soared: a terabyte (1000 GB, 35 to 100 hours of high-definition video) will soon reside on a device the size of a CD (Quain 2005; A new dimension). Conventional hard disks have also become smaller, while increasing in capacity (Miller 2004, Consumer electronics). Parallel developments in compression algorithms allow faster downloads and copying of popular formats such as MP-3 and MP-4, raising the effective storage capacities of existing devices (Murphy 2005; Make your own music 2004; MPEG-4 2005).

Practically speaking, there are few limitations to the capability of technology to store and deliver audio and, increasingly, video in highly portable forms for WBT. By downloading, users can take these materials with them, and use them when convenient, in an expanding variety of smaller and more portable hardware such as iPods, smart phones, and PDAs of various kinds.

M-learning developers see the implications of these technologies for video, but there are also impacts on stalwarts such as text and audio. E-books using e-paper can store up to 500 book-length documents on a portable device (Advanced materials 2005). Downloads are wireless. Portable devices also support podcasting, allowing anyone to produce and disseminate an audio only, or audio-plus-video, product, using only a PC, some
(usually free) special software, and a microphone (with videocamera, if desired). With RSS (variously real simple syndication, or rich site summary) software, Podcasts can be sent ("pushed") automatically to subscribers (Magid 2005, DIY 2005, RSS). These technologies are outgrowths of the phenomenally popular blog (Web log), a method of making one's formerly personal thoughts and experiences available to others, relatively effortlessly. The ease with which these can be produced is even more incentive for good instructional design; poor designs will be all too common, as anyone potentially becomes a producer.

Standards, and Reusable Learning Objects (RLOs)
Training materials are increasingly designed to be reused ("repurposed"), through standards developed by organizations such as the Aviation Industry CBT Committee (AICC), the Instructional Management Systems (IMS) Global Learning Consortium, the Institute of Electrical and Electronics Engineers (IEEE), and the Advanced Distributed Learning (ADL) Initiative of the Department of Defense (developer of SCORM [the Shareable Courseware Object Reference Model]) (SCORM best practices guide 2005). WBT instructional materials developed under RLO standards are portable, for maximum present and future re-use. Metadata tagging of RLOs attempts to ensure several outcomes relevant to potential WBT uses (Longnire 2000):

- **Flexibility**—material is designed for multiple contexts and easy adaptation for reuse.
- **Ease of update, search, and content management**—metadata tags provide sophisticated filtering and selecting capabilities.
- **Customization**—modular learning objects enable more rapid program development or revision.
- **Interoperability**—RLOs operate on a wide range of training hardware and operating systems.
- **Competency-based training**—competency-based approaches are promoted by RLOs; materials are tagged to competencies, rather than subjects, disciplines, or grade levels.

**Evolution of the Internet: “New” Internets**
Worldwide growth in commercial use of the public Web has resulted in ongoing efforts to replace it with a version reserved for research and academic use. In North America, Internet developments include Canada's CA*net 4, and the United States' Internet2.

CA*net 4 uses optical wavelengths to transmit data at a theoretical maximum shared rate of 40 Gbps. termed the first such network in the world, by 2007 CA*net 4 will permit users "to establish and manage their own optical networks within a subset of the whole network" (RISO 2005). Internet2 is a collaboration of 240 U.S. research and academic partners, including industry representatives, government (through the National Science Foundation), and international agencies (including Canada, through CA*net 2), to create an environment that "is not bogged down with music, commercial entities and porn" (Rupley 2002). As with Canada's CA*net series of systems, research and education are the focus (Networking 2002). Both of these new Internets are capable of handling "torrents of data," without "the proliferation of closed architectures, the tendency for companies to protect their interests rather than invest in standards-based solutions, increased security and safety concerns across a wide range of sectors, and ongoing scalability challenges," weaknesses that plague the existing Internet (Talbot 2005).

Although these new versions of the Internet are not yet available for general WBT, they show what a renewed and more regulated Internet might be capable of providing to users, for purposes such as training and education. With the speed, security, applications, and overall stability these new systems promise, WBT would become even more attractive and sustainable (Next Internet 2005).

**CONCLUSION**
All indicators suggest that WBT will continue to expand, grow, and become central to more forms of future training worldwide. That prediction is safe, both because so much has already been invested in the Internet delivery infrastructure and because the Web has already proven to be so effective in reducing direct training costs, increasing access, and addressing serious skills deficiencies in an increasingly competitive and technological world (Kaven 2005). Satellite and cable TV took 35 years to be adopted by 50 percent of North Americans, VHS took 10 years, the Internet 9 years, and DVD 6 years; broadband will likely take still less (Lawrence 2005). The average global citizen appears to have little fear of new technologies; trainers, therefore, can be confident of this tool's continuing role and usefulness into the future. But the evolution of the Web is required to ensure the future of WBT: computers are still too complex, those who support them admit, and their availability is still not sufficiently equably distributed (Behind the digital divide 2005; Pontin 2005). It may even turn out that the computer is the wrong device for some parts of the world to access information and interaction: by price, and direct impact on the gross domestic product, the London Business School argues that cell phones should be distributed to the world's 4 billion poorest people (Calling an end 2005). The infrastructure for that technology may already be in place: 80 percent of the world's population lives within range of a cell-phone network, but only 25 percent have a cell phone (Less is more 2005).

Simple availability or use of a technology are not necessarily the best measures of utility or impact, as the above descriptions of misuse of computer-based applications should make clear. Experience with traditional forms of training delivery have demonstrated that instructional design and conscientious monitoring, perhaps even more than the medium, makes training effective, and trainee support and overall relevance of the content make it appealing to users—lessons that have been available to WBT for some time (Dede 1991).

Although WBT cannot guarantee that future training will not be pedestrian or inefficient, its potential strengths suggest how training of all kinds might be improved. The core elements of the Web as a training tool—ubiquity, accessibility, stability, redundancy, economy, and user-friendliness—are common to other successful teaching
environments. For WBT to expand, developers, managers, trainers and trainees, and employers must see these aspects of the Web as potential assets for their training programs. If the inherent features of the Web are seen as important to training, continued growth and expansion of WBT will occur.

GLOSSARY

Asynchronous: "Different time" (and often different place, i.e., the trainee’s workplace or home) training and interpersonal interactions, made possible by technologies that collect messages and make them available at the convenience of the reader. Examples include e-mail, CMC, and listserver.

Bandwidth: The capacity of a channel (e.g., a telephone line or a coaxial cable) to carry data. High bandwidth permits multimedia (audio, video, animation), while low bandwidth limits users to text or simple graphics, and may preclude VoIP and other new interactive tools.

Computer-Mediated Communications (CMC): Text-based, asynchronous communications, usually restricted by password to a designated group such as a class or training cohort, and moderated to ensure that the discussion stays on topic and is civil.

Content Management System (CMS): Software that permits the arrangement and presentation of training content through various fixed and m-learning devices.

Internet: The public network of linked computers accessible by anyone with a Web browser.

Intranet: A private computer network that may or may not also provide Web access, providing security and control not available on the public Internet by limiting access and controlling the content available to users.

Learning Management System (LMS): A tool for delivering, tracking, and reporting on the progress of trainees using m-learning systems, often in connection with a CMS.

Malware: Any form of malicious code intended to infect a computer or a network, including viruses, worms, and Trojan horse programs.

Markup Languages: Used for placing content on the Web; examples include HTML, XML, and SGML.

Metadata: The identifying material added to reusable learning objects (RLOs) to permit easy reuse or "repurposing."

Mobile Learning (M-Learning): Use of various portable communications devices to access information and training content.

Online: Training that provides synchronous or asynchronous (often Internet-based) interaction between the trainee and the trainer, the training content, and other trainees.

Pervasive Computing: Embedding information into the entire environment of an organization, through use of portable (including wearable) and desktop devices of all kinds.

(Reusable) Learning objects (RLOs): Materials modularized, packaged, and labeled (tagged) to encourage cataloguing, access, and reuse in multiple contexts.

Synchronous: Same time and (often) same place training or communication interactions—for example, face-to-face training.

Training: Instruction in procedural skills and knowledge primarily for practical purposes and relatively immediate application.

Voice (or Video) over Internet Protocol (VoIP): The capability of Internet-based programs to provide voice point-to-point or point-to-multipoint connections to anyone with a browser, a sound card, a microphone, and speakers; may also include limited video or graphics capabilities.

The Web: A synonym for the Internet (in the context of this paper).

Web-Based Training (WBT): Includes training-on-the-job (TOJ) and workplace training, formal on-campus technical training, and elements of training or professional development (PD), including some online components, with the Internet or an intranet as the access/delivery vehicle.

CROSS REFERENCES

See Computer Conferencing and Distance Learning; The Internet Fundamentals.

REFERENCES


OECD. 2005. Key ICT indicators. www.oecd.org/document/23/0,2340,en_2825%54566_39987543_1_1_1_1,00.html (accessed April 22, 2005).


