



CHAPTER 7

CHARACTERISTICS OF INTERACTIVE ONLINE LEARNING MEDIA

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INTRODUCTION

This chapter describes technologies used to overcome distance in online learning. Online learning media are tools for cooperation, collaboration, and communication. These devices allow for provision of individual amounts of teaching presence, structure, learning and technology support, orientation to new roles and processes, and interaction (dialogue) with the tutor and others. Multimedia principles applicable to online pedagogy are described, as are the specific characteristics of individual media-based tools. Developments such as new intranets, inexpensive and more robust hardware, and open-source and social-collaborative tools are discussed. The chapter concludes that distance educators should monitor technological trends in society, as such trends tend to translate rapidly from the culture to the (virtual) classroom.

Online technologies for learning and teaching have continued to evolve and become more varied, though more in developed than

developing countries (UC College Prep, 2006). In 2006, the Internet was estimated to have achieved a penetration of 65–75% in economically developed countries, while the rate in developing countries was only 10–20% (“Fun Facts,” 2007). However, the consensus was emerging that media in widely varying socio-cultural and economic contexts could give “global reach to individual voices...killing once and for all the idea that togetherness requires physical proximity” (“Wireless Nonstop,” 2005).

The impact of media has become dominant in teaching and learning. In 2005, the largest university in the United States was the University of Phoenix, a for-profit institution featuring distance and distributed learning; one of the largest law schools in the U.S. was Concord Law School, all of whose courses are online; and the University of Monterey grew rapidly, using teleconferencing to offer courses throughout Mexico and Latin America. Going online has not, however, proven to be a guarantee of growth and success for educational institutions. For example, Columbia University, Wharton University of Pennsylvania, Temple University, and New York University (NYU) all experienced expensive failures in online programming during this same period (“Higher Education Inc.,” 2005).

In North America, the personal computer (PC) has been the technology of choice for education and training. Early in the new millennium, it was estimated that two-thirds of Canadians over the age of 15 had used a computer in the previous 12 months; 60% of Canadians (90% of students) had a computer at home; and 50% of Canadians (70% of students) had Internet access from their homes (Statistics Canada, 2001). The computer has become so important in developed countries that Negroponte (an architect and computer scientist best known as the founder and Chairman Emeritus of the Massachusetts Institute of Technology’s Media Lab) was able to gain support from countries such as Brazil, Argentina, Libya, Thailand, Nigeria, and China for his *\$100 Laptop or One Laptop Per Child* plan, an initiative that was initially regarded as “wildly ambitious” and a “pipe dream” (Surowiecki, 2006). Today, that verdict has begun to appear both technologically and pedagogically accurate (“Today’s Startup Lesson,” 2007; “Of Internet Cafés,” 2008), but by whatever criteria are applied, it is clear that the computer had demonstrated impressive adaptive capabilities worldwide.

At the same time, a better understanding of some of the limitations of computer-based technology has developed. Oliver and McLoughlin (1998) argue that computers alone cannot transform the learning

experience, and Vrasidas and McIsaac (1999) warn that “intrusive technologies” could actually create barriers to interaction in the online learning climate. Rovai and Barnum (2003) summarize the debate over “media and learning” with the observation that course design and pedagogy are always more important than media, and Walther, Gay, and Hancock (2005) remind technophiles that previous research should not be ignored in their enthusiasm for new tools.

Experience with new media, as technologies and as innovations, might now allow a more balanced assessment of impacts and shortcomings. Advantages, such as greater flexibility for learners, reduced spending on construction, greater computer and technical literacy of graduates, alleviation of overcrowding on campus, the capability to reuse course materials, more capability for transfer and collaborative credit, improved graduation rates, and more attention to the requirements of special-needs students are counterbalanced by disadvantages, such as concerns about quality, issues related to fair treatment of distance faculty, continuing (but declining) scepticism of some employers about graduates of distance programs, and reduced opportunities for spontaneous interaction between faculty and students (Newby, Stepich, Lehman, & Russell, 2000; Grandzol & Grandzol, 2006). A balanced view of technology considers all potential impacts and outcomes.

This chapter attempts to provide a balanced assessment of common distance teaching and learning media. It is based on the assumption that no medium, however technologically elegant, is *de facto* appropriate for all student audiences or learning contexts. The task of practitioners and the purpose of this chapter are to understand and better appreciate the implications of the various affordances and limitations of technologies, and to monitor their readiness for use in online teaching and learning, as they change and develop.

MEDIA IN DISTANCE LEARNING

The following is a discussion of media’s perceived relation to learning, the impact of media on learners’ perceptions of isolation (transactional distance vs. community), and the role of teaching presence in meeting individual learning needs. Santoro, Borges, and Santos (2004) describe the key uses of media as coordination, cooperation, and co-construction. This view reflects the importance of both group goals (“common and

shared”) and individual priorities. While these authors do not use the term “learning communities,” they do nicely describe the process by which learning communities are constructed.

Interactive media support communities, based on *what* people do together, not *where* or *when* (Rovai & Barnum, 2003). Community becomes a *process*, not merely a *place* (Cannell, 1999), in which “structured and systematic” social interaction, using media, is essential to significant learning (Fulford & Zhang, 1993; Ragan, 1999; Dilworth & Willis, 2003; Garrison & Cleveland-Innes, 2005; Conrad, 2005).

In addition to helping communities to develop and evolve, media allow individualized learning, reducing *transactional distance* (Moore, 1991). Online learners experience transactional distance differently (if at all – learning styles and preferences affect perceptions of isolation), requiring varying forms and amounts of interaction, including instructor support (Fahy & Ally, 2005). A major implication is that all interaction is not equally useful; interaction should be adjusted to individual needs and preferences (Walther, 1996; Chen & Willits, 1998).

Responding to individual online learning preferences requires skilled uses of media. In most traditional learning, the learner is largely passive (Garrison & Cleveland-Innes, 2005); online learning designs, on the other hand, usually expect the learner to exercise more autonomy and control (Vrasidas & McIsaac, 1999). Research showing that field-dependent students experience less success and satisfaction with online learning because it is less compatible with their preferred communication style confirms the importance of these learner characteristics (Maushak, Chen, Martin, Shaw, & Unfred, 2000). Another difference concerns structure in the learning environment, usually plentiful in face-to-face situations, and potentially essential where sound study skills or habits may be lacking (Loomis, 2000). The finding that undergraduates tend to benefit less than graduate students from distance methods suggests the importance of maturity, and of a “watchful and helpful” instructor stance (Davies, 1981; Bernard et al., 2004).

To summarize: individual participant’s success with online communication depends on effective use of the technical resources available, along with the guidance and leadership provided by a skilled instructor-moderator (Garrison & Cleveland-Innes, 2005), and tempered by the learner’s own capabilities and preferences for collaborative, cooperative, active, and self-directed learning (Oliver & McLoughlin, 1998). Combined, these factors enable online learners to engage in both collaborative and autonomous adult learning experiences (Knowles, 1980).

It should be emphasized here, however, that individuals do differ and not all students are capable of, nor do they necessarily desire, the same kinds or amounts of autonomy or self-direction in their learning experiences (Grow, 1991). They also differ in important skills. Biesenbach-Lucas (2004) points out that online learners must not only understand ideas and concepts, they must be able to explain them articulately to others, using text. Successful online learners need an environment where they can both acquire and exercise their skills to achieve personal learning goals, and receive compensating media-based assistance and support as required.

The formal learning process should not be a lonely one. Dialogue, as pointed out by Moore (1991), affects perceived isolation and can reduce the need for structure. Mere interaction, however, does not in itself constitute critical discourse (Garrison & Cleveland-Innes, 2005), and talking together does not assure collaboration or “social thinking” among group members (Oliver & McLoughlin, 1998). A key role of instructor-moderators is to provide individually required amounts of structure and dialogue online, through their *teaching presence* (Anderson, Rourke, Garrison, & Archer, 2001).

Teaching presence is the leadership and facilitation necessary for individuals to achieve “meaningful understanding” through interaction and collaboration (Garrison, Anderson, & Archer, 2001). Teaching presence recognizes that students may not spontaneously use discussion effectively, and that collaboration, especially among those still learning its forms, is facilitated by appropriate amounts of structure (Biesenbach-Lucas, 2004). In the terms of Garrison et al. (2001), teaching presence includes design and organization, discourse facilitation, and direct instruction. The inclusion of design as a specific element of the role shows the importance attached by these observers to the systematic provision of structure. It also supports purposeful interaction (discourse) in learning, whether the environment is online or not (Chickering & Gamson, 1987; Beaudoin, 1990; Chickering & Ehrmann, 1996; McCabe, 1997; French, Hale, Johnson, & Farr, 1999).

In summary, two findings in the research on distance education compared with face-to-face instruction, reported by Bernard et al. (2004), are particularly important here, and applicable to the rest of this chapter. First, media research confirms that what the *learner* does with media is more important than what the *teacher* does; second, in terms of student learning outcomes, the *teaching experience* of the instructor does not matter as much as the *instructor's experience with technology*. This finding

underscores the importance to online learners of appropriate media and design, supported by media-competent instructors (Mandell & Herman, 1996; Ragan, 1999; Conrad, 2005).

MEDIA, MODES, AND LEARNING

The following section presents principles that affect the impact of multimedia in learning, distinguishes between media and modes of presentation, and then applies these principles to a discussion of specific tools used in online learning.

Multimedia Principles

The impact of multimedia in teaching, whether online or face-to-face, is dependent upon certain principles. Mayer (2001, p. 184) has suggested seven *multimedia principles*, each with implications for online design and instruction:

1. *Multimedia principle*: Students learn better from words with graphics or pictures than from words alone.
2. *Spatial contiguity principle*: Students learn better when corresponding words and pictures are presented closer to each other on the page or screen.
3. *Temporal contiguity principle*: Students learn better when corresponding words and pictures are presented simultaneously rather than successively.
4. *Coherence principle*: Students learn better when extraneous words, pictures, and sounds are excluded rather than included.
5. *Modality principle*: Students learn better from animation and audible narration than from animation and on-screen text.
6. *Redundancy principle*: People have a limited capacity to process visual and auditory material that is presented simultaneously; therefore, students learn better from animation and narration than from a combination of animation, generation, and on-screen text.
7. *Individual differences principle*: Design effects are stronger for low-knowledge learners than for high-knowledge learners, and for high-spatial-ability learners than for low-spatial-ability learners (Note: *Spatial ability* is the mental capacity to generate, maintain, and manipulate visual images.).

These seven principles and variants independently arrived at by others are referred to in the following discussion.

Media and Modes of Learning

Technologies, as *channels* through which *modes* (symbols acting as stimuli) pass, differ in the responses they evoke. For example, text is a mode of presentation. Print-on-paper is one possible *medium* (channel) for text, but there are others: a computer monitor, overhead projection, a television screen, film (moving or still), the screen of a PDA or smart-phone, and so on. Wherever text is used, it retains its characteristic affordances and limitations (highly portable and compact, but demanding of literacy, for example). Despite their differences, useful online teaching and learning media have in common their ability to bring students into timely contact with their tutors, the content, and their peers (Moore, 1989), by reducing transactional distance (Chen & Willits, 1998).

Although similar in producing these outcomes, the differences in how various technologies accomplish their effects have important implications for online teaching practice. The following is a discussion of some salient differences among media and modes of interaction in distance learning and teaching. (The generic term *tools* can be used to avoid unnecessary distinctions between media and modes of teaching and learning.)

Characteristics of Specific Tools

The following discussion of online tools includes print and text, video and graphics, audio, mobile devices such as PDAs and smartphones, and the Internet. The intention is to summarize some of the technical and pedagogical characteristics of each, in the context of their potential usefulness as tools for online teaching and learning. In the next section, promising developments affecting these tools are presented.

Print and Text

There is still no medium more ubiquitous than print, and no mode of presentation more familiar than text in its many forms. Print was part of the first teaching machine – the book – and books were the first mass-produced commodity (McLuhan, 1964). Print was the dominant medium initially in distance education (Scriven, 1993), and distance students have traditionally spent much of their time in solitary study of text-based materials (Bates, 1995). The strengths and weaknesses of text and print include the following:

Strengths:

- **Cost:** Print is one of the lowest cost one-way technologies (Bates, 1995).

- Flexibility and robustness (Koumi, 1994).
- Portability and ease of production: Especially with desktop publishing, printing has become enormously simpler and its quality much higher (Bates, 1988). Costs may be further reduced with in-house production.
- Stability: Text-only print and online materials can be reorganized and resequenced with relative ease by cut-and-paste operations, using word processors and editors (Kozma, 1991).
- Convenience, familiarity, and economy: Instruction and feedback are facilitated, as are, for the appropriately skilled, higher-order thinking and concept formation (Pittman, 1987).

Weaknesses:

- Print is static, sometimes failing to produce adequate involvement from low-functioning readers; attention, perception, and recall, and active learner participation, may also be reduced.
- Print is relatively non-interactive or non-responsive, and may lead to passive, rote learning.
- Revisions to print materials are more costly and slower than revisions to online databases.
- Print may be seen by some as the “slightly seedy poor relation” of other instructional media (Pittman, 1987).

Text’s lack of appeal is somewhat ameliorated by multimedia-based alternatives to reading, and improvements in voice reproduction technologies that make reading less critical for users, including for the visually impaired (Hadenius, 2004; “Speak to Me,” 2006). With these developments, non-print multimedia-based technologies and utilities that translate text to voice are cost-effectively available in situations where high levels of literacy cannot be assumed, where learners prefer or find auditory content more convenient, or where the costs of reading inaccuracies or inefficiencies are high.

Technical developments may affect the economies and appeal of text and print. Downloadable books, such as the *Sony Reader*, HP’s *ebook*, the *E Ink initiative*, and the Philips *Readius*, make books more available (though not necessarily inexpensive: Amazon’s *Kindle* came to market in 2007 at \$400 [Epstein, 2008]). Some books that are not meant to be read from cover to cover (i.e., directories, encyclopaedias, cookbooks, technical references) are increasingly available in easily searchable digital forms (Makris, 2005; “Readius,” 2005; Greene, 2006; “Not Bound By Anything,” 2007; “White OLEDs Brighten,” 2007; “Displays To Keep An Eye On,” 2007).

A worrying finding in relation to technology and literacy is the suggestion that extensive technology use early in life may inhibit reading later: a national survey of children in Britain in 1997 found that 23% said they did not like reading, a proportion that by 2003 had risen to 35% (“Catching Up,” 2006). This trend obviously must be monitored and its relation, if any, assessed as to the timing of technology introduction.

Given the above, the trend to make online reading materials even more accessible may seem somewhat ironic. *Google’s* book digitizing project, intended to place all non-copyright books on the Web, continues (Roush, 2005), and e-textbooks have been piloted in Canada at Mount Royal College in Calgary and the University of British Columbia in Vancouver (Schmidt, 2007).

Graphics and Video

Earlier research showed that graphics can increase the motivation of users to attend, prompt their perception and aid recall, and assist in the development of higher-order thinking and concept formation (Saettler, 1990; Szabo, 1998). Furthermore, still (non-animated) graphics combine high information content (illustrating abstract or unfamiliar concepts) with relatively low production and distribution costs. Online compression formats, such as JPEG, permit ready distribution of high quality graphics. This factor is particularly relevant when delivery is to PDAs, smart-phones, or other mobile devices with limited bandwidth, display, storage, or memory.

The advantages of various forms of video content in actual practice continue to be debated. In some studies, animation has been shown to result in “more efficient learning” (Szabo, 1998, p. 30). There is, however, also some indication that when compared with “highly imaginative examples and illustrations,” the advantages of animated simulations are less obvious (Rieber & Boyce, in Szabo, 1998, p. 30).

General graphics principles include the following (Dwyer, in Szabo, 1998, p. 20):

- Visuals that emphasize the critical details relevant to learning are most effective. Unnecessary visuals may be distracting, especially to learners with limited attention spans or discrimination skills. (See Mayer’s [2001] multimedia principles, above.)
- The addition of detail and realism to displays may not increase learning; unnecessary detail can add to learning time without increasing achievement, and increase transfer times. Depending

on the relevance of detail to the learning task, simple line drawings may be superior to photographs or more realistic drawings.

- Winn (in Szabo, 1998) cautions that diagrams, charts, and graphs should not be assumed to be self-explanatory; graphics should include clearly written supporting captions.

Colour is routinely expected in online instructional materials, but designers and user should be aware that, with the exception of instruction that directly employs colour for teaching (e.g., identifying colour-coded elements), there is little evidence that colour enhances learning, and it may even distract some users (Dwyer, in Szabo, 1998, pp. 38–39). Some other generalizations about colour follow:

- Colour may increase the speed at which lists can be searched.
- Too many colours may reduce the legibility of a presentation.
- The most highly recommended colours are vivid versions of green, cyan, white, and yellow.
- Colours may be displayed differently by various receiving technologies.
- End-users should be able to control colour in displays, given the prevalence of colour-blindness (found to some degree in 8% of men and 0.5% of women); the best colour display combinations are blue, black, or red on white; or white, yellow, or green on black (Rockley, 1997).

Based on his review of the data, Szabo (1998) concludes that “the disparity between effectiveness and perceived effectiveness is nowhere as great as it is in the realm of colour” (p. 27).

For online uses of still graphics, the following characteristics of the computer as a delivery medium should be noted by developers (Rockley, 1997):

- A PC screen is about one-third of a piece of paper in display area (hand-held devices may be much smaller), and most display devices are less sharp than the best laser printers or photographic reproductions. What works on paper may not work, without translation or redesign, online. (Also, designers should not assume that users have superior equipment; design should be for displays of mid-range quality.)
- Screen positioning is critical: important information should go to the top-left; the lower-left is the least noticed area of the page/screen.

- Single-colour backgrounds, with a high contrast ratio between the background and the text, are easiest for readers; white or off-white is best for the background (see above).
- Textured backgrounds display differently on various systems, and should be used with care, if at all.
- Sans serif fonts, with mixed upper and lower case, are best for legibility and reading ease.
- The size of the font depends on the purpose. For extended reading, smaller (12–14 point) fonts are suitable; for presenting information that will be skimmed or scanned, larger fonts may be more appropriate.
- Font changes (size and type) can be effective for emphasis, as can capitals, underlining, and especially bolding. The use of colour alone for emphasis should be avoided.

All of the above techniques should be used sparingly, to preserve their impact (Rockley, 1997).

Videoconferencing

According to Roberts (1998), videoconference sessions have the following pedagogic characteristics. They

- add a sense of direct involvement and physical presence among geographically dispersed learners.
- provide quality learning opportunities (as good as or better than those offered by other methods and technologies).
- provide live, interactive learning opportunities to distant sites, including delivery of global expertise to remote learners.
- eliminate or reduce travel time.

The following strengths of videoconferencing for learning and teaching can be exploited with appropriate instructional strategies.

Teleconferencing

- fosters social presence and cohesion among users, and may improve motivation.
- permits the sharing of visual resources, including demonstrations.
- makes collaborative learning more attractive and feasible.
- may help in the teaching of abstract, time-protracted, hazardous, or unfamiliar concepts.

Design is important in videoconference-based learning. According to Roberts (1998, p. 96), critical issues in video-based training include

1. proper training of instructors
2. user self-consciousness
3. integration of other media into video-based presentations
4. optimum length of sessions and size of groups
5. session variety
6. technical design and support
7. professional quality visual elements

Cost and accessibility remain issues with online video of all kinds (Bates, 1995). Costs vary enormously in video implementations (Simpson, Pugh, & Parchman, 1993). The Halo videoconferencing system, launched in late 2005 and highly regarded (“Halo: Video Conferencing Done Right,” 2006), was priced at its inception at \$550,000 to install, and \$18,000 per month to run. Its customers, including DreamWorks, HP, PepsiCo and other multinationals, could afford the high costs (“Halo Effect,” 2005), but potential educational users likely could not. If one-way video and two-way audio are used, costs drop dramatically, as does the bandwidth needed. The least expensive variant (when amortized over large numbers of users) is one-way video with one-way audio (a broadcast), but there are significant pedagogical implications.

Audio: iPods®, MP3 players, and VoIP

The *iPod*®, Apple’s downloadable audio device, has become the standard for portable music (sales reached 100 million units and 2.5 billion songs in 2007 (“Apple Said,” 2007). Pontin (2007) regards the iPod® (along with the Palm® and the BlackBerry®) as not only highly functional but “beautiful designs” for technology (p. 10). The fact that Apple has made *iTunes*® software compatible with the Microsoft operating system, a previously unthinkable concept, suggests that this protocol and the iPod® will remain this medium’s standard (“You’ve Heard This Song Before,” 2006). In comparison, early versions of *Zune*, Microsoft’s iPod® competitor, were not capable of receiving podcasts or video downloads (Ulanoff & Costa, 2007).

In Canada, experiments in learning with iPods® have been conducted at the University of Guelph, the University of Saskatchewan, and Carleton University (Hounsell, 2006). Video iPods® provide full lecture downloads (sound and pictures), or live streaming. Some observers question whether these technologies will be commercially successful beyond the early adopters who made them popular initially (Miller,

2006a); others (in one case, a Google vice-president) predict continued evolution and expansion for educational purposes (“Pocket Power,” 2007). Standards defining best practices for the design of mobile-learning (m-learning) materials have appeared (Rabin & McCathie-Neville, 2006), largely driven by security threats (Rubenking, 2007).

With MP3 software, users can download or *rip* (copy), mix, encode, convert, clean, and organize audio files, and then *burn* (copy) them to CDs, DVDs, or flash-based devices like iPods® (“Make Your Own Music,” 2004). The MP3 compression algorithm employs “psychoacoustic theories” to achieve smaller file sizes (Murphy, 2005). The software also permits editing and copying of JPEG video files.

Podcasts permit iPods® and MP3 players (or other portable or mobile digital media players) to download lectures or other presentations. Interest in these media appears age-dependent: 50% of 18- to 28-year-olds have engaged in podcasts, compared with only 20% of 29-year-olds and up (“Podcasting Hits the Mainstream,” 2005).

Voice-over Internet protocol (VoIP), like the other broadband-dependent technologies in this group, was regarded as a highly promising new technology immediately after it appeared (Pescovitz, 2003). Subsequent rulings in the United States by the Federal Communications Commission (FCC), reducing regulations and oversight of VoIP, made this a “new standard for voice communications” (Miller, 2004, p. 7). Versions of VoIP (*Vonage*, *Skype*) that allow users to plug traditional telephones into computers to make free long-distance phone calls globally have great social (and educational) potential (“The War of the Wires,” 2005). For teaching, synchronous voice-based tools such as *Elluminate* (see <http://www.illuminate.com/>), *iLinc* (see <http://www.ilinc.com/>), *Dimdim* (see <http://www.dimdim.com/>), and *Paltalk* (see <http://www.paltalk.com/>) provide a virtual space for learning interactions, including excellent audio, whiteboard (with *PowerPoint* display capability), web-touring and desktop control, textbox chat, small-format videocam, and various teacher tools (i.e., hand-raising, microphone control, individual note exchange, quiz utility, graphing capability for math, and tools for students to provide feedback to the presenter. (Dimdim is open source.)

Audio in teaching raises technical – storage and bandwidth – as well as pedagogical challenges. Online audio can be particularly useful in teaching for several reasons (recall Mayer’s [2001] multimedia principles):

- An audio summary of previous material can aid recall, help retention, and promote concept formation and higher-order thinking.

- Although audio in many formats may be asynchronous (DVDs, *iPods*®, blogs), and therefore one-way and non-interactive (like a lecture or a radio broadcast), these access-delivery formats offer significant learner control (Morgan, 2007).
- DVDs persist because they are relatively easy and cheap to produce and ship, but downloadable audio (and video) are more accessible to the end-user, and increasingly preferred by users.
- The mode of presentation most often found in this medium, the human voice, is a familiar and powerful teaching tool.
- Audio may be more motivating than print alone, and together with print may form a powerful alternative and aid to reading alone (Newby et al., 2000).

An important issue in selecting a mix of other technologies for use with synchronous audio is the relative pedagogic importance of *relationship building* vs. *information exchange*. Picard (1999) sees synchronous audio's key contribution as its ability to promote relationship-building. The need for other technologies, according to Picard, is dependent upon the degree to which there is also a need to exchange information (for which, she warns, audio may not be particularly effective).

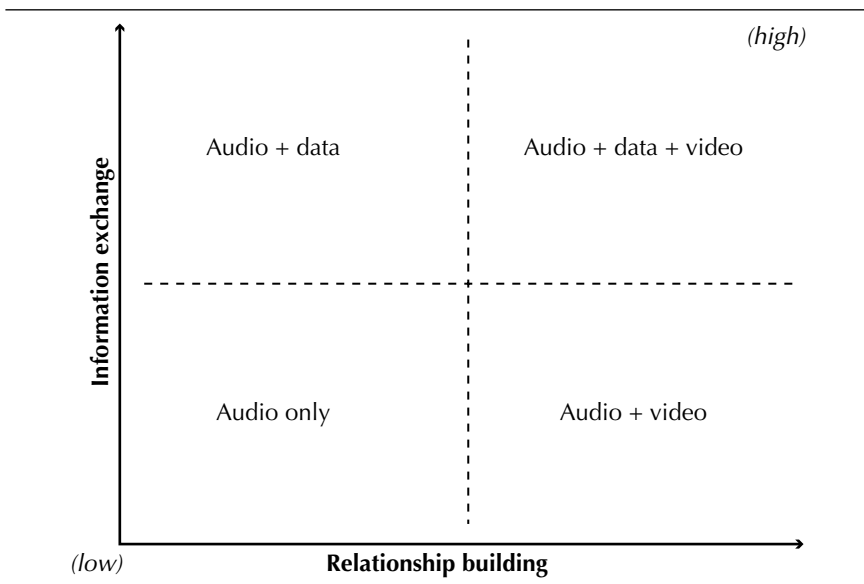


FIGURE 1. Association of synchronous audio, data exchange, and video presence, with information exchange and relationship-building objectives (Picard, 1999)

In Picard's (1999) analysis, when the needs for relationship building and information exchange are both low, audio alone may suffice. When both needs are high, however, audio, video, and data (including text) should all be present. Relationship building can be enhanced by combining audio-conferencing and video with data, especially text. (Text has formidable relationship-building capabilities, as anyone who has ever had a pen pal knows, but literacy is required, and the absence of non-verbal cues, especially body language, can be inhibiting, as noted earlier.) Video increases the likelihood that interaction will promote relationships, while audio alone is less capable of promoting this outcome. Data exchange alone seems to do little to promote relationships among those with access to no other form of interaction.

As technological evolutions permit more audio-based delivery, both synchronous (interactive such as VoIP or wireless) and one-way (streaming) audio research findings become applicable (Szabo, 1998):

- Learning gains from one-way audio alone are, at best, weak (a form of Mayer's [2001] *multimedia principle*).
- Learners possessing higher verbal skills usually do not benefit from audio added to text (Mayer's *individual differences principle*).
- There are little or no apparent immediate recall effects between text-only and text-plus audio, except that, on occasion, audio may lengthen the time required to complete instruction (Mayer's *modality* and *redundancy principles*).
- The quality and utility of digitized speech depend upon the amount of compression, the sampling rate, the bandwidth available, and the quality of the device.
- Users may relatively quickly become accustomed to synthetic speech; however, more cognitive effort is needed, and increased demands on short-term memory may reduce retention. (Synthesized speech may be more useful in reading back a learner's work, for example from a word processor, than in presenting unfamiliar learning content.)
- For general audiences, the possible benefits of audio must be weighed against the increased costs. Exceptions include uses such as language training, music instruction, and as an aid to the visually impaired.
- Where possible, the learner should be able to decide whether or not to use available audio (another form of Mayer's individual differences principle).

PDA's

The probable future direction, at least in the short term, of video for online teaching can be seen in *personal digital assistants* (PDAs), smart phones, and other handheld devices. PDAs are small, wireless, highly mobile Internet receivers which, despite their size, can deliver movie-length video. On PDAs, a feature film requires a megabyte of memory for each minute, permitting a 128 Mb memory card to store two hours of video (Rupley, 2003). The emergence of very small, high-capacity (2GB) *microdrives* boosted the popularity of PDAs for a time (Rupley, 2005), but the emergence of highly capable *smart phones* has led some observers to comment that PDAs might become a “dying breed” (DeFeo, 2004; “The Device That Ate Everything?” 2005).

High bandwidth is essential for mobile video. Ultrabroadband, wireless video cellphones support voice- and email, web access, MP3 audio, picture-taking capability, video clips, and, of course, telephony. With robust support, high broadband speeds and an accepted mobile wireless standard (“Mobile Net,” 2007), and assuming the threat of phone viruses can be controlled (Hutson, 2005; “Airborne Outbreak,” 2005; “Why Wait for WiMax?” 2005), a major delivery vehicle for distance education and training may evolve from this technology (Copeland, Malik, & Needleman, 2003). Paulsen (2003) and Rekkedal (2005) report the use of devices such as pocket PCs/PDAs with portable keyboards and mobile phones at Norway’s NKI, as part of accessibility projects (although Rekkedal added that the team was still “uncertain” as of his report whether such technologies comprised a mobile learning “future solution”).

The Internet

As noted at the outset of this chapter, *online learning* almost always denotes learning on the Internet, which offers both advantages and challenges to educators and trainers. The advantages arise from the Internet’s enormous capacity to link participants with information and with each other (Haughey & Anderson, 1998). Problems with navigation, structure, interactivity, complexity, security, stability, and time wasted by undisciplined or confused users does affect its usefulness, however.

The Internet is potentially a powerful linking and communication vehicle, surpassing one hundred million web sites in 2007 (“Watching the Web Grow Up,” 2007). Heinich, Molenda, Russell, and Smaldino (1996) suggest that the Internet’s power lies in its capacity for providing

rapidly growing numbers of connections to potentially engrossing, multi-sensory experiences, while remaining adaptable to individual needs. The fact that the Net can be modified by teachers themselves, can be tailored to individual students' needs, and can support meaningful collaboration and interaction also makes it a potentially powerful learning tool.

At the same time, there are weaknesses. The Web's inherent lack of structure may result in some users getting unintentionally "lost in cyberspace" or making poor use of their time (surfing or exploring interesting but irrelevant minutiae). Also, especially in "Web 1.0" (Borland, 2007), Internet materials may lack interactivity, providing merely a one-way presentation of information. The reliability of information on the Internet may also be suspect. Finally, successful use of the Internet currently demands proficient literacy and computer skills.

The Internet offers a means for gaining the attention of learners, and of presenting opportunities for focusing perceptions and prompting recall. Learner participation can also be supported, especially with computer-mediated communications (CMC) and the use of collaborative learning projects. Providing instruction and assuring appropriate organization, sequencing, and higher-order outcomes are less easily accomplished with the Internet, for reasons discussed below.

Web 2.0 and the emerging Web 3.0 are intended to address some of these problems. Web 2.0 is characterized by tagging, social networks, and user generation of content, using tools such as Wikis, blogs, and podcasts. Web 2.0 is called the "writing web," because it allows individual users to create and circulate their own materials (Borland, 2007). The present web (Web 1.0) was originally planned to be two-way, but as it grew exponentially in the late 1990s, publishing tools failed to keep up with web browsers in ease of use; now, with the rise of blogs and wikis, the balance is being redressed ("Watching the Web Grow Up," 2007).

Growth and acceptance of Web 3.0, called the "Semantic Web," is predicated on three areas of development: 1) the spread of Internet access to millions of new users via mobile devices; 2) growing interest in this technology's potential socially; and 3) the practice of consistently labelling information so that it makes sense to machines as well as people ("Watching the Web Grow Up," 2007). The Semantic Web incorporates widespread mobile broadband access to full web services, including technologies that allow computers to organize and draw conclusions from online data. In Web 3.0, online content is encoded so that computers are capable of locating and extracting the information. In this version of the Web, machines will be able to read web pages much as humans

do, and software agents will “troll the Net and find what they’re looking for” in an Internet that will resemble “one big database” (Metz, 2007, p. 76).

Many authorities believe the above cannot happen within the existing Internet, due to the fact that the present Web has become increasingly “fragile” (Talbot, 2005), and because of the immense challenge of accurately ascribing standardized forms of metadata to the millions of items already on the Internet.

PROMISING DEVELOPMENTS

Developments such as new versions of the Internet, more equitable Internet access globally, social software, and the open-source movement constitute promising new developments in media evolution.

New Internets

New versions of the Internet are being developed to address the weaknesses of the old. Because of problems described above, both Canada and the U.S. have projects to create a new high-speed Internet to serve the research and academic communities worldwide. As well, the National Science Foundation (NSF) in the U.S. is studying the feasibility of developing “clean-slate” Internet architectures that will be secure, accommodate new technologies, and be easier to manage (characteristics the current Internet manifestly lacks). Talbot (2005) reports that among these are the university-based programs PLANETLAB (Princeton), EMULAB (University of Utah), DETER (USC, Information Sciences Institute), and WINLAB (Rutgers). Two National Science Foundation initiatives are the Global Environment for Networking Innovations (GENI), and Future Internet Design (FIND). GENI is a redesign project for Internet protocols and applications, and FIND is intended to generate a new vision of the future Internet (“Reinventing the Internet,” 2006). Shibboleth, an open-standard authentication system under development at Brown University, is an element of the Internet2 project, and a sign that the new Internets will better address present security and management concerns (Talbot, 2006a).

All of the above initiatives are prompted by various assumptions, some of which are applicable to virtual and distance education:

- Present world-wide Internet growth, already very high, will continue.

- World-wide Internet-based research, and academic, government, and corporate cooperation and collaboration, will continue and increase.
- The Internet has proven it is a powerful tool for productive collaboration and communication.
- Governments have a responsibility, in the national interest, to fund and maintain such a network (NGI, 2001).
- Ease of use, power/speed, cost, and accessible content determine the growth of wireless Internet developments (Machrone, 2001).
- Designers will assure that new Internets will not be more failure-prone as they become more complex, employing more leading-edge technologies (Talbot, 2005; "The Next Internet," 2005).

Reality-based Internet Access for the Developing World

In much of the developing world, or where necessary infrastructure elements (such as reliable power) cannot be assumed, sophisticated computer-based communications and access systems are not feasible. In such instances, technologies must recognize both socioeconomic and technological issues. Alternate-powered technologies are more suitable, in the form of wind-up medical devices ("Power From The People," 2008), communications tools ("Human-Powered Health Care," 2004), radios (Freeplay Foundation, 2006), and computers that derive their power from springs (Miller, 2006b), or even from the energy of the typist's keystrokes (Pontin, 2005). The ability of developing societies to skip over stages of infrastructure growth (adopting wireless, for example, without first becoming fully "wired") is a major reason that emerging nations move more quickly than developed ones to adopt new technologies ("Of Internet Cafés," 2008).

Other technologies, such as the cellphone, may also turn out to be more useful than computers in some societies. There were 2.8 billion active cellular telephones (cellphones) worldwide in 2007 ("A World of Connections," 2007), and purchases of cellphones that also function as PDAs vastly increased in the preceding two-year period (Roush, 2005). At that time, some 80% of the world's population lived within range of a cellphone network, but only 25% owned a cellphone ("Less is More," 2005). These facts make cellphones a potentially important global wireless communications technology, a "genuine productivity tool" (Kamen, 2003) capable, in the minds of some, of spurring economic growth and timely learning ("Cellphones vs. PDAs," 2004). Some believe the

economic impact of cellphones could powerfully affect social development in third-world countries, improving gross domestic product (GDP) and reducing poverty (“Calling an End to Poverty,” 2005). The potential of this technology can be seen in the Bangladesh Grameen Phone project (“Power to the People,” 2006; “Yogurt or Cucumber?” 2008); the TradeNet initiative in Africa, which exploits the fact that over 60% of the population now have cellular coverage – expected to rise to 85% by 2010 (“Buy, Cell, Hold,” 2007; “A Cash Call,” 2007); and the benefits that downloading books from satellites to Linux-based PDAs, avoiding print altogether, has had on the availability of quality training resources in rural areas of developing countries (Talbot, 2006b; “Calling For a Rethink,” 2006).

Social Software

Social software refers to software that supports group interaction (Shirky, in Owen, Grant, Sayers, & Facer, 2006). Lefever (cited in Anderson, 2005) is less general, and suggests the educational potential of these tools: “Where normal software links people to the inner workings of a computer or network, social software links people to the inner workings of each others’ thoughts, feelings and opinions” (p. 4).

Boyd (in Owen, et al., 2006) refines the definition further, specifying three types of interaction support provided by social software:

- Support for *conversational interaction between individuals or groups*, from real-time instant messaging to asynchronous collaborative teamwork, including blogs.
- Support for *social feedback*, in which a group rates the contributions of others, producing a *digital reputation* for participants.
- Support for *social networks* to explicitly create and manage participants’ personal relationships, and to help them develop new ones.

Owen and colleagues (2006) have observed that social software also causes changes to community function: the group benefits from others acting in more social, community-oriented ways – the social whole becomes greater than the sum of its parts. This concept reflects the belief that important knowledge and significant learning opportunities may be missing from mainstream institutions and traditional learning environments, and that the design of most learning management systems and related software fosters isolation and competition rather than community. Social software emphasizes the importance of interpersonal interaction in groups that are dedicated to learning and teaching. There is the expectation that learning structures, including tools and

environments, will reflect and facilitate social equality, collaboration, cooperation, and mutual support.

In education and training situations, social software encourages *collaborative, community-oriented learning*, based on *voluntary affiliation and participation*. Members join these learning groups motivated by intrinsic interests, rather than the pursuit of credentials, credits, or other extrinsic motivations. Instead of being assigned membership in classes or programs, participants seek out others who possess the knowledge that matches their needs or interests, join voluntarily, and, using social software systems, contribute to group success by learning and, when appropriate, teaching (Wikipedia, n.d.a). Groups are based upon trust and are democratically governed. Conrad (2005) found that such groups, drawing on the group's resources, were more able to identify – and survive – poor teaching.

Any medium that promotes collaboration, group formation, and support could qualify as social software. Anderson (2005) suggests that social software is defined by the activities it supports, such as “meeting, building community, providing mentoring and personal learning assistance, working collaboratively on projects or problems, reducing communication errors, and supporting complex group functions” (p. 4), and by its other affordances, such as “combinations of blogging, portfolio management, discussion and file sharing, group file management, and search and linking capacity” (p. 8).

Presently, examples of social software include instant messaging, Internet relay chat (IRC), Internet forums, blogs (weblogs), wikis, social network services, peer-to-peer social networks, massively multiplayer online games, virtual presence sites, even social shopping applications (Wikipedia, n.d.a). (Note: Wikis are “an effective tool for *collaborative authoring*,” and “a type of *web site* that allows the visitors themselves to easily add, remove, and otherwise *edit* and change some available content, sometimes without the need for registration” [Wikipedia, n.d.b])

Social software, though popular, has its critics. Dvorak (2006) calls virtual immersion experiences “a complete waste of time,” since “there’s no hint of reality and its consequences in these worlds” (p. 138). *Second Life* itself has been called “lawless” (Talbot, 2008). Recognizing these criticisms, New York University planned a “Facebook in the Flesh” session for incoming freshmen in 2007, believing that undergraduates immersed in online interaction might need help relating to classmates face-to-face (Shulman, 2007).

Further, some research shows that social networks do not benefit from Metcalfe's Law, which, in relation to traditional networks, holds that the value of a network is proportional to the square of the number of users. Social networks, on the other hand, appear to lose value as membership increases; one Silicon Valley forecaster comments, "the value of the social network is defined not only by who's on it, but by who's excluded" ("Social graph-iti," 2007, p. 83). By this perspective, exclusivity, not accessibility, is an online social network value (Costa, 2007), because "people want to hobnob with the chosen few, not to be spammed by random friend-requests" (p. 83).

Finally, there is also evidence that participation in some of these more self-revelatory virtual environments may be short-lived for many who try them. Dalton (2007) reports that, while 175,000 new blogs were started daily in early 2007, half of those blogs were abandoned within three months, leaving 200 million inactive blogs on the Internet. While some observers disagree (citing the trend to commercialization and corporate uses of blogs as an indication of their vitality), Dalton predicted that the number of authentically active blogs would level off after 2007, at about 30 million.

Open Source

Open source began as a reaction to the power that proprietary software makers were seen to wield (sometimes symbolized by Microsoft's alleged monopolistic practices). Open-source supporters advocate the use of software that is open to modification, and is free (or nearly so), as a way of supporting experimentation and competition, features they regard as lacking in both the organizations and the software packages of the big software producers. While open source may have begun as a reaction, it has become a credible movement, representing a growing and diverse community of seasoned information technology professionals who, because so many are involved and check each other's work, produce software of consistently high relative quality (Constantine, 2007; Goldman, 2007).

The appeal of open source is broad: the movement is supported by companies such as Sun Microsystems, AOL, American Express, Novell, and Bank of America, as well as the UK's Ministry of Defense and the French tax authority. Corporate users of Linux, the open-source operating system, include Orbitz, Schwab, L.L. Bean, and the New York Stock Exchange; Linux is supported by IBM, Hewlett-Packard, Dell, Intel, Oracle, and Google, (Null, 2003; Miller, 2003; Ferguson, 2005; "Business,"

2005). In late 2006, Linux was selected to become the operating system of the world's fastest computer (Rupley, 2006). It was predicted that, by 2008, 6% of operating systems shipped by commercial vendors would be Linux-based (Roush, 2004). Linux server software was growing at 40% annually in 2005, while the rate for similar Windows products was less than 20% and Unix usage was declining (Ferguson, 2005). The suggestion that Linux servers were considerably more resistant to malware attacks than Windows servers helped to pique interest (Vaughan-Nichols, 2005).

The desire to address the problem of too-centralized software development may ironically contain another serious issue, however:

Because there are so many individual voices involved in an open-source project, no one can agree on the right way to do things. And, because no one can agree, every possible option is built into the software, thereby frustrating the central goal of the design, which is, after all, to understand what to leave *out*. (Gladwell, 2005, 132)

There may also be questions of intellectual property rights in open-source products, since no one author is completely responsible for them ("Open, But Not As Usual," 2006). Obviously, if not addressed, these criticisms could constitute serious obstacles to the eventual success of the open-source movement. There are also strong opposing arguments for the standards, support, and sheer endurance of commercial software, such as Windows (Miller, 2005).

CONCLUSION

Online learning continues to mature in relation to media and technologies, and to an appropriate pedagogy for their use. There are many outstanding and, in some cases, vexing issues: costs, though declining, still limit widespread access, especially in the developing world, and for those whose purchases (including seemingly constant upgrades) are not subsidized; further training remains a need for many (teachers, trainers, and learners) to assure mature use of online media and systems (Garfinkel, 2003; Bernard, et al., 2004); administrators and policy-makers often misread or oversell the likely impacts of going online (Nikiforuk, 1997; Dvorak, 2002), resulting in confusion, disappointment, and, in

the worst cases, recriminations and disillusionment; systems and interfaces generally remain too complex (Fahy, 2005); and the relation of learning outcomes to technology use, for specific populations and in particular circumstances, remains unclear, at least partially because it is under-theorized, (Garrison, 2000; Walther, et al., 2005), but also because so much research on technology use in distance learning is weak (Rovai & Barnum, 2003).

At the same time, there are promising signs, especially in post-secondary education and training (“Higher Education Inc.,” 2005; Rhey, 2007). Access to the Internet is improving, especially for some previously disenfranchised groups (U.S. Department of Commerce, 2004; OECD, 2007; Miller, 2006b; “Fun Facts,” 2007). For example, women as a group have for some time exceeded men in numbers of Internet users (Pastore, 2001). Some consensus about good practice is emerging, including models of clearly successful uses of technology to meet persistent user (including learner) needs (“Inculcating Culture,” 2006). And much needed in-service training is increasingly available to users and potential users (Biesenbach-Lucas, 2004).

Will these useful trends continue? Change has been a constant in the online learning world, so that as technical capabilities come out of the lab, they are quickly packaged and made available to users by entrepreneurs. Education could keep pace and avoid the costs and uncertainties of invention by following the technological lead of the corporate sector, and of society in general, and learning from their experiences.

Whether online learning follows this path or not, it has a good chance to grow, because online access to training using various media is an established social and economic reality globally (“The Best is Yet To Come,” 2005). Whether one deplores or applauds this fact, it is still true that as a society, we increasingly go online for a widening array of purposes, including learning. The implications for every educator – especially distance educators and trainers – are becoming more obvious.

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