The Future of Distance Learning Technology: It's Not About the Technology and It's Not About the Distance

J. Michael Spector

Introduction

Many forms of learning involve some use of technology. Technology is inherently involved in distance learning. Some educational researchers and instructional designers claim that digital technologies are transforming the landscape of learning (e.g., see Visser and Visser-Valfrey 2008). Claims that technology has transformed learning are difficult to defend partly because it is a causal claim and partly because such claims are typically quite vague and general in scope. Nevertheless, one can easily find such claims in the refereed research literature as well as in popular magazines and trade journals. The fascination with new technologies and new technology-based approaches can lead to suboptimal learning designs and implementations (Kirschner et al. 2006; Perkins 1991; Spector and Merrill 2008). I have argued elsewhere that educators have a fundamental responsibility to first do no harm (Spector 2005). Improper use of technology and some instructional designs can further disadvantage students who lack proper preparation and training. In rare cases, a learning environment or instructional system can fail to teach critical skills resulting in undesirable consequences in real-world settings (e.g., see Dörner and Wearing 1995; Dörner 1996).

J.M. Spector, Ph.D (✉)
Educational Psychology and Instructional Psychology, The University of Georgia,
Athens, GA 30602, USA
e-mail: mspector@uga.edu

L. Moller and J.B. Huett (eds.), *The Next Generation of Distance Education: Unconstrained Learning*, DOI 10.1007/978-1-4614-1785-9_2,

If one adopts a skeptical attitude (i.e., an inquiring attitude driven by a sense of not knowing but wanting to learn more) with regard to particular technologies and learning approaches, one might be better positioned to fairly examine evidence of what works best in various circumstances. Merrill (2002) has attempted to do this, and he argues that instruction is likely to be effective when:

- Centered around meaningful problems and tasks.
- Learning goals and tasks are explicitly linked to knowledge and skills already mastered.
- New knowledge and skills are demonstrated in their natural context.
- Students have opportunities to work on a variety of related problems and tasks of increasing complexity with feedback from a variety of sources.
- Students can regulate their own performance and integrate new knowledge and skills into other activities.

In conjunction with the attitude of a skeptical inquirer, it is important to consider what evidence to collect and how it might be analyzed. All too often, assessments in educational research are based on superficial indicators of outcomes and fail to probe deeply. Learning is typically defined as involving stable and persisting changes in abilities, attitudes, beliefs, knowledge, or skills. Moreover, what we often want students to learn are skills, knowledge, and attitudes that will be important to their development and productive lives in society—at least one can find such claims in many academic and technical training programs. However, it rarely happens that evidence is presented of stable and persisting changes partly because such evidence is costly to collect and difficult to analyze. However, without meaningful assessments that are linked to intended goals and objectives that look at both proximal and distal outcomes, we are left to our intuitions and prejudices—instructional science degenerates into instructional alchemy.

Spector et al. (2003) argue that meaningful assessments are likely to develop when they are:

- Linked to meaningful and representative problems and tasks
- Aimed at helping students further develop knowledge and skills
- Used to assess real problem-solving abilities relative to prior performance and against established standards of competent performance
- Provided by multiple credible sources, including the learner, in a constructive context
- Designed to develop the ability to self-regulatory and metacognitive skills

It is probably fair to say that Merrill's (2002) instructional principles and the principles for meaningful assessment indicated above are not widely implemented. There are of course other instructional and assessment principles that could be cited that might be more widely known, accepted, and implemented. Nevertheless, I shall proceed on the basis of these principles and develop an argument about their relevance to distance learning.

Distance Learning

I adopt a standard definition of distance learning as learning that occurs in a context in which students are typically separated from their instructors on computer-based instructional agents, and typically from each other, for more than 75% of a course or instructional program. This is similar to the definition used by the Sloan Consortium (see Allen and Seaman 2010) as it includes a percentage of time so that distance learning can be distinguished from hybrid learning environments. The simplest definition of distance learning is learning in which students and teachers are separated by time and place. That early definition included the use of texts delivered to remotely located students as well as the use of video- and audioconferencing and the Internet. For my purposes, the actual definition that is adopted will not ultimately matter, because my argument is that regardless of the separation in time or place, or differences in language and culture, or percentage of the course involving such separations, what matters most is whether and to what extent learning occurs.

However, there is value in having a definition as it allows one to examine what is happening in comparison with other types of learning. For example, enrollment in distance learning courses continues to grow far in excess of increases in enrollments in traditional courses (Allen and Seaman 2010). In spite of that growth and in spite of evidence that distance learning tends to have a positive impact on the economy, faculty and administrators tend to have an increasingly negative attitude with regard to distance learning (Allen and Seaman 2010). The decline in attitudes on the part of university faculty, most of whom are not involved in distance learning, can be explained in part as a perceived threat to the prominence of traditional university faculty. A meta-analysis conducted by Means et al. (2009) found that students in distance learning courses in higher education performed better than their counterparts in face-to-face courses. A meta-analysis conducted by Storrings (2005) showed that attrition in university distance learning courses was comparable with that in face-to-face courses rather than much higher as many people believe. The findings from the meta-analyses, mostly confined to online courses in the USA, go against common beliefs that students do not learn well in distance settings and that there are high rates of attrition in distance learning courses.

It would appear that distance learning is being held to different standards than face-to-face instruction. This may in part be justified by an institution wanting to ensure that its image and reputation are not negatively impacted by distance learning courses that it offers, as these tend to be more visible than the instruction that occurs within the walls of the university. I find such a justification quite weak, however. Poor classroom instruction, particularly in large lecture settings, can also harm the image and reputation of an institution. Large lecture hall classes need not be deadly boring or ineffective, but they often are (Centra and Gaubatz 2005; Marsh et al. 1979). Distance learning courses, by contrast, are typically small with enrollments often capped at between 20 and 30. Limiting class size is a positive step towards effective instruction, although the size of the class has been shown not to have a large impact on learning outcomes (Ellis 1984; Smith and Glass 2005) except for very small groups and one-on-one tutoring.

What makes instruction effective? What makes good distance learning good? I have addressed these questions elsewhere (Spector 2007, 2008) and offer here a condensed version of my reasoning. Instructional design research tends to follow this line of thinking: (a) one can usually identify and document deficiencies in student or worker performance, and (b) an identified deficiency is a target for improvement, often through instruction. Two kinds of instructional improvement are usually proposed: (a) develop and implement improved instructional methods—these often new technologies and new approaches (possibly new blends of traditional approaches); only a few empirical studies demonstrate that a different method is in fact more effective (Richey et al. 2004), or (b) develop and implement improvements in instructor preparation and training; these may also include new technologies and approaches, and there are even fewer empirical findings demonstrating that improved instructor preparation and professional development have a sustained and positive impact on learning, which is not what we would all like to believe.

There are many evaluations of courses, both distance courses and face-to-face courses, since many institutions require student and teacher evaluations at the end of a course. Are these data reliable, and do they help answer the question, what makes a good distance learning course good? It seems reasonable to believe that the experiences reported by teachers and students would offer some indication of the quality and effectiveness of a course. However, the evidence suggests that good results seem to be correlated with a perception that students have positive attitudes with some being especially knowledgeable and well prepared prior to the course (Boone and Kahle 1998; Chen and Hoshower 2003; Filak and Sheldon 2003). It is then critical to gather attitudinal and motivational data at the beginning of a course, but this is rarely done. Some researchers record career preferences and changes in these preferences as indicators of a successful course, which is one, among other possible indicators (Yager and Yager 1985).

What is it that makes a good distance learning course good? Many will say that a good course sustains interest and promotes understanding. A reliable predictor of performance is time spent mastering a task (Ericsson 2004; Slavin 1998). Admitting that one does not know but wants to know (humility) and believing that one can learn with an appropriate level of effort (optimism) appear critical for effective learning—these attitudes might be considered preconditions for success on the part of individual students. Of course, to defend the claim that learning did occur, there must be independent measures of gains in knowledge and performance. A good distance learning course is one that promotes understanding, as indicated by measures of knowledge and performance, while sustaining interest, as indicated by preferences and subsequent actions on the part of students. This is true also for face-to-face courses.

Are distance learning courses different from face-to-face courses? Many obvious differences exist, particularly with regard to the required knowledge, skills, and expectations of teachers and students. Standards for judging the success of online courses ought to be comparable with those used to judge face-to-face courses. However, more emphasis on preparing and supporting distance learning teachers is a recognized requirement. Online environments require teachers to develop specific competencies (Klein et al. 2004). The good news in this regard is that many universities recognize that specific competencies are required for effective online instruction and are developing courses, workshops, and seminars to help teachers develop those competencies. Unfortunately, there is still too little emphasis on properly preparing students for success in distance learning courses, although the International Board of Standards for Training, Performance, and Instruction (ibstpi; http://www.ibstpi.org) has adopted this as a priority issue.

I have tried to establish two things thus far. First, distance learning courses are different in many ways from face-to-face courses. Differences exist with regard to the design of effective instruction as well as with regard to the preparation of teachers and students. Second, the factors relevant to determining the effectiveness of distance learning are basically the same as those pertinent for face-to-face courses. Admittedly, there are additional challenges in collecting and analyzing data in distance settings, but the underlying measures of learning effectiveness remain basically the same regardless of technologies and modalities used. I have presented this claim in other contexts, and it is generally accepted without much discussion; of course, that does not make the claim true. However, I have also tried to suggest that what typically happens in assessing learning and evaluating courses in distance settings reflects something altogether different—distance courses are evaluated by simplistic cost-effectiveness models (Spector et al. 2003), and individual assessment in distance learning courses is even more superficial than it is in face-to-face courses (Johnson et al. 2009).

Engineering Education

An example in aeronautical engineering education at the United States Air Force Academy (USAFA) will serve to illustrate many of the points made thus far. This case summary is based on my personal knowledge of the situation, which unfortunately was never formally documented. The case involves learning and instruction in the introductory aeronautical engineering course at USAFA in the period of time roughly between 1965 and 1985, prior to the advent of distance learning but well within the period in which computer technologies made their way into classrooms.

An overwhelming majority of USAFA freshmen would select aeronautical engineering as their initial choice for a major; this was true in 1965, as well as in 1985, and it was obviously encouraged by USAFA administration. However, after taking the first course in aeronautical engineering, a significant number of cadets would change their major to something else, such as International Relations or Civil Engineering, leaving less much less than half the cohort still majoring in aeronautical engineering. In the 1980s, the course was redesigned to be highly experiential with the support of sophisticated interactive simulations. The data on a standard final exam for this course were in USAFA archives covering a period of nearly 30 years. These data were examined to see whether knowledge and performance improved with the introduction of the redesigned course. Whether or not the final exam was a fair indicator of knowledge and performance was not examined.

The course redesign was extensive and quite dramatic, introducing small group projects oriented around the new simulation-based learning environment; there was no textbook; and groups were encouraged to design the most effective solutions to a number of increasingly challenging aeronautical engineering problems. However, there was virtually no improvement in final exam scores. Was the redesign a failure? Hardly. What did change significantly was the number of cadets who retained their aeronautical engineering major. The design was effective in terms of the objective to have cadets major in aeronautical engineering and pursue careers in the air force related to aeronautical engineering. One conclusion is that a distance learning course need not be more effective than its face-to-face counterpart in order to be considered a success. A second conclusion is that it is not only learning and performance that make a course good—looking at longer-term impact is also relevant. A third conclusion is that sustaining interest in an area is perhaps a worthwhile goal, and this can be easily measured; it is certainly true that technology can be used to gain and sustain interest as well as to promote instructional efficiency, and these are important considerations for the design of distance learning courses.

It is worth bringing this story from 1985 to 2010 with a brief look at what is happening in the area of engineering education in general. As with many other technologies, digital engineering technologies are becoming much more powerful as well as smaller and more affordable. Digital fabrication is a case in point. Cornell University researchers have developed tools for desktop fabrication and 3D printing (http://ccsl.mae.cornell.edu/papers/HOMA08_Vilbrandt.pdf). The Fab@Home project at Cornell is dedicated to building and using machines that can make almost anything at almost any location. The hardware designs and software are provided by Cornell at no cost and are open-source (http://www.fabathome.org/wiki/index.php?title=Main_Page). The FAb@Home kit costs about $1,600; for about $2,000, one (teacher, student, school, or researcher) can have a fully functional desktop fabricator linked to CAD software with supplies to support the creation of a number of physical objects.

The focus at Cornell has been on the technology—on creating powerful, flexible, and affordable digital fabricators. It is clear that engineering practice will make even more extensive use of digital fabrication in the future. It makes sense that engineering education should be using similar tools to prepare future engineers. The Cornell technology offers three significant affordances for education. First, it allows a student to see the consequences of a design in a 3D object quite quickly—rapid prototyping is made effective and affordable. Second, it allows a student in one location to share the design with a student at a different location who also has the fabricator. Language and culture are bypassed by the actual prototype the remote student prints using the 3D printer. Because the technologies are digital, the important modeling process required to create designs that can be fabricated easily lends itself to use in distance learning. Moreover, these digital designs can be easily shared via the Internet across the boundaries and barriers of language, culture, and prior preparation and training. Finally, because the devices used to print and fabricate are affordable, they can be placed in many different settings, and they reflect what professional engineers are doing on the job. These uses of technology make meaningful distance learning in the area of digital engineering quite affordable and practical.

The following remarks are taken from my blog (http://aect-president-2009-2010.blogspot.com/):

> The 3D printer also could be controlled by modeling or CAD/CAM software. This printer is available for the remarkably low price of $1,600. Here is how it works—you will of course have to use your imagination. First the layout/specifications for the three dimensional object are entered into a modeling or CAD/CAM program. This layout controls the printer which is a customized version of an inkjet printer that uses tubes instead of ink cartridges. The tubes can hold any stuff that will solidify after exposure to room temperature air—this includes liquid metals and plastics, latex, and even CheezWhiz. Gee whiz. Really? Really! The printing occurs a layer at a time with each layer being about 1 mm thick. On each pass, the printer squeezes the molding material out of the tubes according to the specifications in the modeling program. Gradually, layer by layer, the 3D object is created. We saw bicycle chains, chess pieces with embedded objects, a metal impeller, and other complex objects that had been printed using this technology. Imagine that. For about $2,000 you and your students can be in the business of creating all sorts of objects. Cornell is pursuing this line of research in part due to its tremendous educational potential. Since modern engineers use similar tools to prototype and test various objects, it makes sense to train engineers using the tools, technologies, and techniques they will encounter after graduation. How obvious is that? The challenge was to create affordable technologies for use in university engineering programs, and it appears that Cornell has succeeded. Imagine that college students in Ithaca, New York can create plans for objects that could be viewed, refined, and printed/created by college students in Beijing, China.

Concluding Remarks

Thanks in part to such remarkable technologies, we have come a long way in enriching education, and the possibilities and implications for distance learning are significant and the possibilities and implications for distance learning are significant (Carr-Chellman 2005). In spite of such amazing possibilities, we still need to regard learning as a process involving stable and persistent changes in abilities, attitudes, beliefs, knowledge, performance, and skills, then we need to take care to design, implement, and evaluate appropriate assessments.

References

Allen, J. A., & Seaman, J. (2010). *Learning on demand: Online education in the United States, 2009*. Report for the Sloan Consortium. Newburyport, MA: The Sloan Consortium. Retrieved June 18, 2010, from http://www.sloan-c.org/publications/survey/pdf/learningondemand.pdf.

Boone, W., & Butler Kahle, J. (1998). Student perceptions of instruction, peer interest, and adult support for middle school science: Differences by race and gender. *Journal of Women and Minorities in Science and Engineering, 4*, 333–340.

Carr-Chellman, A. A. (Ed.). (2005). *Global perspectives on e-learning*. Thousand Oaks: Sage Publications.

Centra, J. A., & Gaubatz, N. B. (2005). *Student perceptions of learning and instructional effectiveness in college courses*. A report for the Educational Testing Service. Princeton: Educational Testing Service. Retrieved June 18, 2010, from http://www.ets.org/Media/Products/perceptions.pdf.

Chen, Y., & Hoshower, L. B. (2003). Student evaluation of teaching effectiveness: An assessment of student perception and motivation. *Assessment and Evaluation in Higher Education, 28*(1), 71–88.

Dörner, D. (1996). *The logic of failure: Why things go wrong and what we can do to make them right* (R. Kimber & R. Kimber, Trans.). New York: Metropolitan Books.

Dörner, D., & Wearing, A. (1995). Complex problem solving: Toward a (computer-simulated) theory. In P. A. Frensch & J. Funke (Eds.), *Complex problem solving: The European perspective* (pp. 65–99). Hillsdale: Lawrence Erlbaum.

Ellis, T. (1984). *Class size*. ERIC digest number eleven. Eugene, OR: ERIC Clearinghouse on educational management. Retrieved June 18, 2010, from http://www.ericdigests.org/pre-922/size.htm.

Ericsson, K. A. (2004). Deliberate practice and the acquisition and maintenance of expert performance in medicine and related domains. *Academic Medicine, 10*, S1–S12.

Filak, V. F., & Sheldon, K. N. (2003). Student psychological need satisfaction and college teacher course evaluations. *Educational Psychology, 23*(3), 235–247.

Johnson, T. E., Ifenthaler, D., Pirnay-Dummer, P., & Spector, J. M. (2009). Using concept maps to assess individuals and team in collaborative learning environments. In P. L. Torres & R. C. V. Marriott (Eds.), *Handbook of research on collaborative learning using concept mapping* (pp. 358–381). Hershey, PA: "http://www.igi-global.com/reference/details.asp?ID=34574" \o "Information Science Publishing" \t "_blank" Information Science Publishing.

Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential and inquiry learning. *Educational Psychologist, 41*(2), 75–86.

Klein, J. D., Spector, J. M., Grabowski, B., & de la Teja, I. (2004). *Instructor competencies: Standards for face-to-face, online and blended settings*. Greenwich: Information Age.

Marsh, H. W., Overall, J. U., & Kesler, S. P. (1979). Class size, students' evaluation, and instructional effectiveness. *American Educational Research Journal, 16*(2), 57–70.

Means, B., Toyama, Y., Murphy, R., Bakia, M., Jones, K. (2009). *Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies*. Report for the U.S. Department of Education, ED-04-CO-0040. Washington: US Department of Education, Office of Planning, Evaluation and Policy Development. Retrieved June 18, 2010, from http://www2.ed.gov/rschstat/eval/tech/evidence-based-practices/finalreport.pdf.

Merrill, M. D. (2002). First principles of instruction. *Educational Technology Research and Development, 50*(3), 43–59.

Perkins, D. N. (1991). Technology meets constructivism: Do they make a marriage? *Educational Technology, 13*, 18–23.

Richey, R. C., Klein, J. D., & Nelson, W. A. (2004). Developmental research: Studies of instructional design and development. In D. H. Jonassen (Ed.), *Handbook of research on educational communications and technology* (2nd ed., pp. 1099–1130). Mahwah: Lawrence Erlbaum.

Slavin, R. E. (1998). Effects of student teams and peer tutoring on academic achievement and time on task. *Journal of Experimental Education, 48*, 253–257.

Smith, M. L., & Glass, G. V. (2005). Meta-analysis of research on class size and its relationship to attitudes and instruction. *American Education Research Journal, 17*(4), 419–433.

Spector, J. M. (2005). Innovations in instructional technology: An introduction to this volume. In J. M. Spector, C. Ohrazda, A. Van Schaack, & D. A. Wiley (Eds.), *Innovations in instructional technology: Essays in honor of M. David Merrill* (pp. xxxi–xxxvi). Mahwah: Erlbaum.

Spector, J. M. (Ed.). (2007). *Finding your online voice: Stories told by experienced online educators*. Mahwah: Erlbaum.

Spector, J. M. (2008). What makes good online instruction good. In J. Visser & M. Visser-Valfrey (Eds.), *Learners in a changing learning landscape: Reflections from a dialogue on new roles and expectations* (pp. 251–266). Dordrecht: Springer.

Spector, J. M., Doughty, P. L., & Yonai, B. A. (2003). *Cost and learning effects of alternative e-collaboration methods in online settings* (final report for the Andrew W. Mellon Foundation cost effective use of technology in teaching initiative). Syracuse: Syracuse University.

Spector, J. M., & Merrill, M. D. (2008). Special issue: Effective, efficient and engaging (E^3) learning in the digital age. *Distance Education, 29*(2), 153–164.

Spector, J. M., Milrad, M., & Davidsen, P. I. (2003). Model facilitated learning. In S. Naidu (Ed.), *E-learning: Technology and the development of teaching and learning*. London: Kogan Page.

Storrings, D. A. (2005). A*ttrition in distance education: A meta-analysis*. Unpublished dissertation, Syracuse University, Syracuse, NY.

Visser, V., & Visser-Valfrey, M. (Eds.). (2008). *Learners in a changing learning landscape: Reflections from a dialogue on new roles and expectations*. Dordrecht: Springer.

Yager, R., & Yager, S. (1985). Changes in perceptions of science for third, seventh, and eleventh grade students. *Journal of Research in Science Teaching, 22*(4), 347–358.

http://www.springer.com/978-1-4614-1784-2

The Next Generation of Distance Education
Unconstrained Learning
Moller, L.; Huett, J.B. (Eds.)
2012, XXVI, 266 p., Hardcover
ISBN: 978-1-4614-1784-2