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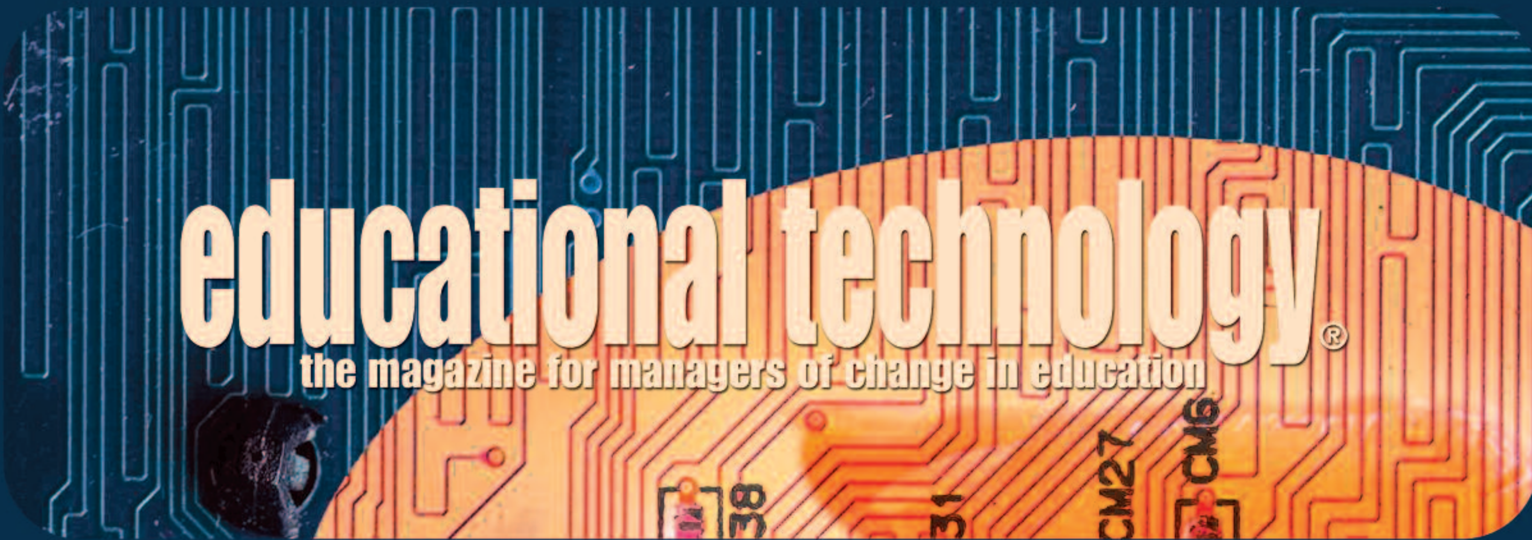

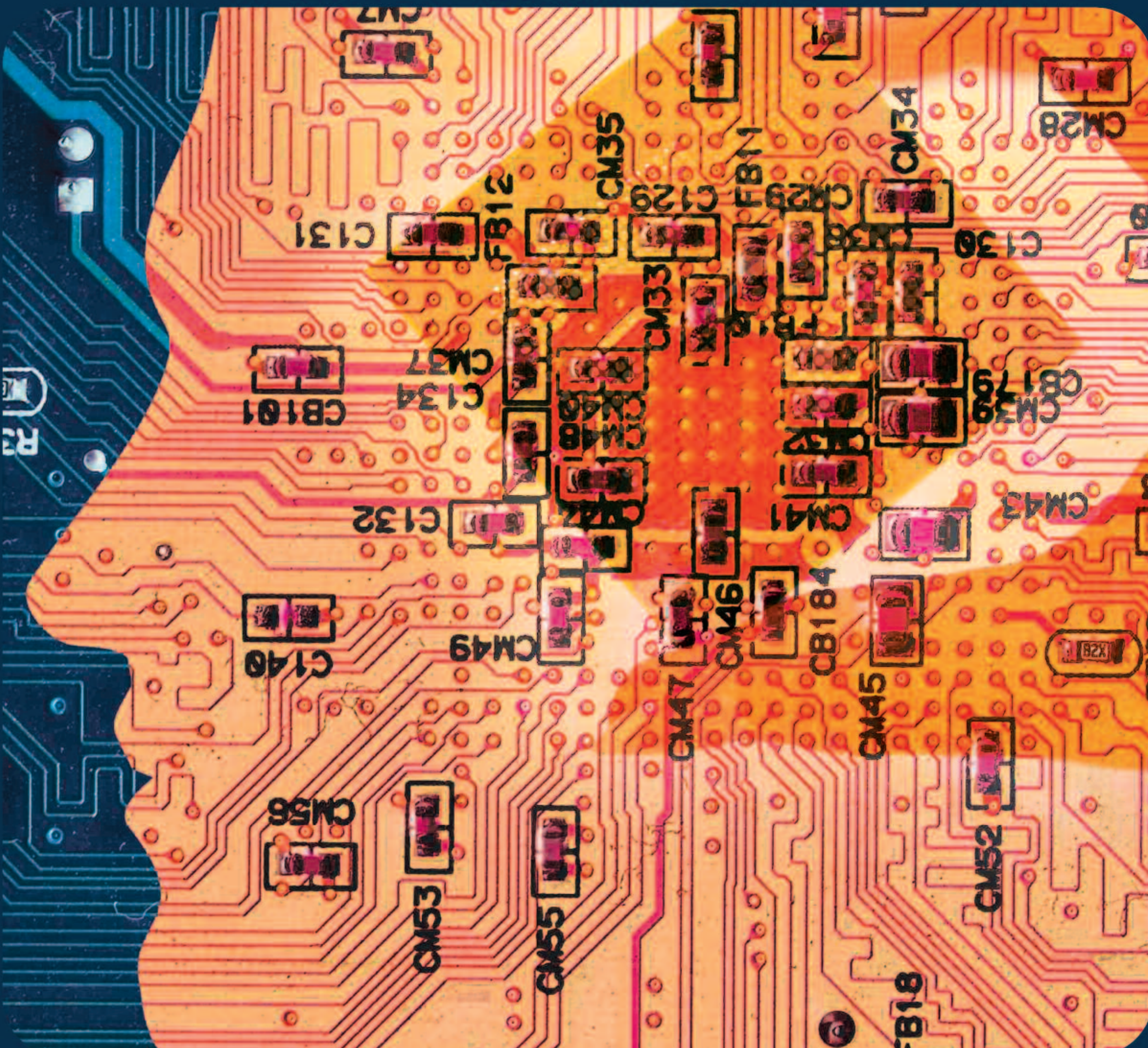

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A general issue covering varied aspects of educational technology

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The Transformation of Learning with Technology

Learner-Centricity, Content and Tool Malleability, and Network Effects

Michael D. Bush
Jonathan D. Mott

Educational visionaries and reformers have long predicted a significant transformation of teaching and learning that would be facilitated by technology, essentially providing every learner with the equivalent of a personal tutor. Technology implementations in education, however, have consistently fallen short of achieving these lofty aims. The authors argue that this failure stems from a penchant to implement technology in ways that automate that past. Instead, we must champion learning technologies that are learner-centric and malleable, such that they address the needs of individual learners and can take advantage of the power of network effects. Only then will we realize the long-awaited transformation.

Introduction

The 1960s was a decade of upheavals, but it was also a decade of dreams, full of grand visions of a better world. At the beginning of that momentous era, actor Bob Cummings helped fuel the national fascination with flying cars when he purchased and piloted an Aerocar on his TV show ("Chuck," 2008). With similarly futuristic vision, Stanford philosopher Patrick Suppes predicted in a 1966 *Scientific American* article that "in a few more years millions of schoolchildren will have access to what Philip of Macedon's son Alexander enjoyed as a royal prerogative: the personal services of a tutor as well-informed and responsive as Aristotle" (Suppes, 1966, p. 201). Unfortunately, both visions of the future have proven too optimistic. The sky is not filled with flying cars and every child is not blessed with the services of their own private "Aristotle."

Why haven't our most visionary dreams been realized? Why hasn't technology dramatically improved learning? The promised technology-driven transformation of education seems tantalizingly just out of reach. We're left to ask, metaphorically speaking, "Dude, where's my flying car?(!)" We argue here that educational reformers and academic technology strategists are waiting in vain for the promised revolution in teaching and learning because we have consistently, almost single-mindedly, used technology to automate the past instead of employing our best thinking and efforts to create a new future. Specifically, otherwise well-intentioned reformers have missed opportunities to create learning content and tools that are open, modular, and interoperable.

Because "openness" has taken on various and sometimes ideological meanings, it is appropriate for us to clarify what we mean by the term "open." Our intent is to describe tools, processes, and frameworks that interoperate in an open fashion to create and deliver content that is itself accessible, flexible, and repurposable. We do not hold that tools or content need to be "free" (as in "no-cost") to be open. For example, a closed source, commercially provided tool might have an open architecture that is extensible via APIs or Web services. In contrast, an open source tool might be very proprietary in terms of the kinds of applications and databases with which it will interface; thereby creating content that is quite closed. We contend that the prior is legitimately more "open" than the latter. The nature of openness that matters most to learners, teachers, and the institutions that support them is the ability to quickly and easily find, customize, and implement the right tool or content for specific learning contexts. By this view, open source software or open content (i.e., freely distributed under a Creative Commons license) is not inherently better than or normatively superior to commercially provided and licensed tools or content. Supporting effective, dynamic learning is the primary aim—the nature of the tools used and their source are both of secondary importance.

This being said, we believe that openness, including the kind of radical new openness championed by the open source and open content communities, is a

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critical enabling factor in the transformation and improvement of learning. Imagine a world in which anyone, anywhere, could use exactly the right tools and content at the right time, seamlessly with the other tools and content they already use, to solve their teaching and learning challenges. Can there be any doubt that the prospects for online teaching and learning would improve? Accordingly, we believe that it is crucial to promote openness *combined with* the principles of modularity and interoperability to facilitate the development of new tools and methodologies for reusing, remixing, and mashing-up content to achieve learning goals in ways never thought possible.

By leveraging such ideas, teachers and learners can more fully take advantage of the network effect in technology by enabling learning communities. Significantly increasing the output in learning content has the potential to fundamentally alter the learning landscape, just as the Web in general has changed the information landscape. Finally, we argue that perpetuating teacher-centric, didactic models of education prevents fundamental, paradigm-altering changes in learning and accompanying role changes. We conclude that teachers and academic leaders must embrace these principles—namely openness, modularity, interoperability, the network effect, and learner-centricity—for the full potential of learning technology to become widely available, usable, and affordable.

The magnitude of this potential is illustrated by research from the 1980s that ascertained the value of one-to-one tutoring (Bloom, 1984). Benjamin Bloom, perhaps best remembered for his "Taxonomy of Educational Objectives," quantified what Aristotle and his predecessors, Socrates and Plato, no doubt believed: that one-to-one tutoring is the most effective way to facilitate learning. While the Industrial Revolution's "mass-production" methods of learning have dramatically expanded our capacity to educate more people, the quality of that education has not been on par with personalized instruction. Indeed, Bloom quantified this gap, concluding that students learning with a tutor had on average an advantage of *two standard deviations* above the mean of "mass" educated students. Bloom recognized the obvious impracticality of the implications of his finding. He declared that an "important task of research and instruction is to seek ways of accomplishing this under more practical and realistic conditions than the one-to-one tutoring, which is too costly for most societies to bear on a large scale." Bloom dubbed this challenge the "2-sigma problem" (Bloom, 1984, p. 4), which led him and his students to attempt to devise methods of group instruction that are as effective as one-to-one tutoring.

The Nature of the Dilemma

While the sort of individual, computer-based tutoring Bloom envisioned is possible to some extent (Fletcher, 2008), the widely available and affordable implementation thereof remains more a dream than a reality. To argue, however, that technology hasn't changed, and at least marginally improved, teaching and learning would be nonsensical. Indeed, with well-conceived Google searches, learners today can at least partially realize Suppes' vision— they can effortlessly access far more information than even a sage such as Aristotle could have ever accumulated and retained through a lifetime of study. Efficient access to information, however, is not the equivalent of responsive human tutors, the kind of "teachers" Suppes predicted would be readily available to children everywhere.

Suppes was not alone in making such optimistic prophecies about the impact of computers on education. In 1968, for example, George Leonard described computer-based learning in the most glowing of terms. Both his rhetoric and the title of his book on the subject, *Education and Ecstasy*, are much in keeping with the writing of someone known as the "granddaddy of the consciousness movement" (Gelman, 1991). After visiting schools across the country, Leonard reflected on the wrongs that fill the world, "war, disease, famine, racial degradations, and all the slaveries man has invented for his own kind," concluding that none of these "is deeper or more poignant than the systematic, innocent destruction of the human spirit that, all too often, is the hidden function of every school" (Leonard, 1968, p. 110). In the chapter entitled "Visiting Day, 2001 A.D." he described an ideal future in which personalized computer-based learning would be the norm. The computers in his vision would implement "Ongoing Brain-wave Analysis" and could teach learners the basics of any subject area in a fraction of the time required in conventional schools, encouraging "uniqueness rather than sameness in learners" (p. 145). The biggest challenge that Leonard foresaw in such a world would be "what to do with the extra time gained in the new mode of learning" (p. 144).

Although the conundrum observed by Bloom is less transcendental than Leonard's vision of schools in our day, the comparison between vision and reality is startling in either case. Not only has "Ongoing Brain-wave Analysis" not materialized, but schools around the world struggle with the limitations of outdated systems for learning. Not only do schools continue to fall short of bridging the 2-sigma gap, but their performance is disappointing on many levels as they fail to meet even the basic education needs of the Information Age.

This is especially true in the United States, where students are falling further and further behind many of their counterparts around the world in science and math, as measured by an international exam sponsored by the OECD Program for International Student Assessment (PISA) ("Something," 2007). This report provides a discouraging view of American education, prompting three K–12 leadership groups to warn that technology was not playing a sufficiently important role in education in the United States:

> How will we create the schools America needs to remain competitive? For more than a generation, the nation has engaged in a monumental effort to improve student achievement. We've made progress, but we're not even close to where we need to be.
>
> It's time to focus on what students need to learn—and on how to create a 21st century education system that delivers results. In a digital world, no organization can achieve results without incorporating technology into every aspect of its everyday practices. It's time for schools to maximize the impact of technology as well. (SETDA, ISTE, & P21, 2007, p. 2)

A host of scholars and educational leaders have argued for decades that technology can and should play a wide and effective role in addressing learning shortfalls (Bunderson & Abboud, 1971; Bunderson *et al.*,1984; Fletcher, 2003; Kulik & Kulik, 1987). Indeed, a brief review of 1967 issues of *Educational Technology*, for example, reveals a very interesting picture, one filled with hope regarding what digital technology would be able to do for education. Young (1967), for example, observed:

> Since knowledge is multiplying at a geometric rate, it is inconceivable that students of the future will be fed this information on the same basis that they are today. Instead, facts will be available when needed. The teacher will not stand in front of a group and lecture, giving information or checking the children's production. The pupil studying the problems will use a teacher as a consultant, and paraprofessionals, the library, the computer, and other materials will be used as resources when he needs them. (p. 4)

Other observers predicted similarly profound changes, including (1) the abolishment of grade levels, (2) significant changes in the role of the teacher, and (3) the implementation of new learning methods and learning technology ("Experimental," 1967). One university president lauded the availability of a single computer "solely for use by our 5,000 undergraduate and graduate students" while the chairman of that university's computer committee declared, "The computer is becoming integral to 20th Century society. It is not only an instrument for the scientist and engineer, it is also a tool for business and professional men" ("Computers," 1967, p. 19). These visionaries believed the future of research, learning, and business would all be fundamentally changed by technology.

Finally, the Associate Commissioner for Research of the U.S. Office of Education, R. Louis Bright, predicted in 1967 that: "programmed instruction, instructional TV, computerized instruction, and use of other new media will increasingly be important factors in providing education of the scope and depth our young people need. How else can we provide the necessary sustenance for increasing enrollments, characterized by a multiplicity of threads of interest, wide variation in learning styles and rates of progress, and great diversity of motivation and goals" (Bright, 1967).

These visions of dramatic learning improvement have been largely unrealized, despite the passage of four decades. But the visionaries persist in predicting a brighter future. More recently, at the height of the dot-com bubble, such enthusiasm even made its way to the pages of *Business Week*, in the form of a quote by Howard Block, an analyst at Banc of America Securities, who stated that "There will be a tremendous migration away from classroom learning to online learning" (Symonds, 2000). The article also cited widely repeated predictions that education would be the next "killer app" for the Internet. More recently, Secretary of Education Margaret Spellings convened a series of three roundtable discussions involving not only individuals from various quarters of education and from technology companies but also students. The report from the proceedings of those meetings concluded that new Internet and Web 2.0 technologies made available via affordable computing platforms "can help us redefine the way education is provided to students so that learning can take place anytime, anywhere, and at any pace" ("Harnessing," 2008, p. 3).

Such anticipation notwithstanding, even cursory visits to a randomly selected sample of classrooms at any level of American education would quickly reveal that there is neither a mass migration afoot nor a "killer app" that is transforming education. Mary Ann Wolf, the executive director of State Educational Technology Directors Association (SETDA), lamented that the level of benefits received from technology use in our schools is nowhere near what it should be: "Our educational system has a long way to go before the potential of technology to improve teacher quality, increase rigor, and maximize efficiencies is realized" ("Partnership for 21st Century Skills," 2007). Worse yet, some observers maintain that not only has the potential of educational technology not been reached, but a great deal of money is being wasted on purchasing educational technology that is either not being used to its full potential (Cuban, 2001) or is in fact being used when it should not be (Stoll, 1999).

How and why have we fallen short? If the optimistic prognostications of technology-hawking reformers were realized, Larry Cuban argues that technology should have visibly improved education in three ways: (1) schools should be more effective and productive, (2) learning should be more engaging and connected to real life, and (3) students should be better prepared for the workplace (Cuban, 2001, pp. 13–15).

To test the validity of these expectations, Cuban examined the impact of massive technology investments in K–20 education in Silicon Valley. His conclusions are not terribly optimistic—he found little evidence that the resulting technology infusion in a very supportive environment has yielded any significant changes in teaching strategies (p. 130). On the contrary, Cuban concluded that, by and large, "teachers used technology to maintain existing practices" rather than to "revolutionize" the way they teach their students (p. 138).

Once again, history repeats itself. Teachers in Silicon Valley, where resources and attitudes are favorable to a technology-enabled teaching and learning revolution, have responded to new technologies much like their predecessors responded to film, radio, and instructional television. In those cases the adoption curve was slow, but over a long period of time, even the most stubborn "laggards" began using films and television in their classrooms. But the new technology did not lead to the transformation of teaching and learning practices. Rather, new technologies became "peripheral to the daily routines of teaching and learning," much like today's new technologies are for today's teachers (p. 140). Perhaps even more worrisome are the results Cuban uncovered at Stanford University. Notwithstanding the university's investment in thousands of computers, network connections in dorm rooms, and computer labs, teaching and learning activities remained largely unchanged: "Lecturing still absorbs more than half to two thirds of various departments' teaching practices.…These traditional forms of teaching seem to have been relatively untouched by the enormous investment in technologies" (p. 171). Similarly, Secretary of Education Spellings' roundtables concluded that a major part of the challenge of the implementation of new technology is that it "has been applied to the outside of the education process, rather than as a critical tool in revamping the process itself" ("Harnessing," 2008, p. 9).

Cuban's analysis and the conclusions of the Department of Education roundtables lay bare the fundamental challenge faced by educational technology strategists, policy-makers, and reformers. The vast majority of educational technology implementations to date have been focused on making things more effective and efficient for institutions and teachers, and not necessarily on improving outcomes for learners. We should not be surprised, then, that educational technology has not significantly transformed and improved learning.

Although the application of computers to education has greatly outpaced the availability of flying automobiles, the impact of digital technology for learning has been significantly less profound than was anticipated by Suppes, Leonard, and others. Indeed, the kinds of computerized tutors reformers have envisioned are still far from providing individualized learning support tailored to the needs of individual students, at least beyond a few limited example demonstrations. And so we're left disappointed. Our cities' skies are not filled with airborne cars, and human beings continue to learn in about the same ways they did forty years ago.

The Tipping Point: Facilitating a Transformational Learning Revolution

If technology has thus far failed to yield revolutionary changes and improvements in teaching and learning, what sorts of technology changes or implementation approaches might make a difference in the future? While technology and content standards are important, we believe that merely refining standards and implementing them more consistently and more widely will not, in isolation, dramatically improve, let alone revolutionize, teaching and learning. Nevertheless, one is left with the frustrating impression that all of the necessary puzzle pieces are on the table; we have but to figure out how to put them together. So how do we turn small, relatively isolated examples of successful technology innovation into a revolutionary transformation of teaching and learning?

This is precisely the kind of question Malcolm Gladwell tackles in *The Tipping Point* (2002). A tipping point, he explains, is that "one dramatic moment in an epidemic when everything can change all at once" (Gladwell, 2002, p. 2). For Gladwell, an epidemic need not be a negative health phenomenon, like a virus. Instead, it can be a sudden change in public attitudes that results in lower crime rates, or the sudden adoption of a new fad by millions of teenagers. His primary thesis is that there are critical junctures in time or space at which relatively small, insignificant phenomena can become epidemics—IF the right "tipping" factors are present.

So what exactly does a tipping point look like? First, it's a point in time at which unusual or uncommon practices turn into "contagious behaviors," morphing from the ordinary to the viral in an instant (p. 7). Second, small, seemingly insignificant things can cause the tip, resulting in "big effects" (p. 8). Lastly, when something tips, the change happens in one dramatic moment (p. 10). Even casual observers of the impact of technology on teaching and learning might sense that we are at or near a tipping point. But we are left to wonder what "contagious behaviors" and "small, seemingly insignificant things" will cause the tip to occur?

Gladwell identifies three key "causes" of a tipping event: (1) the influence of a few key individuals, (2) the "stickiness" of the message, and (3) the context in which all of this plays out (see the *Introduction*).

First, Gladwell argues that the "the law of the few" is crucial to every epidemic. There are almost invariably three small but important groups of people who help bring a phenomenon to its tipping point. First, there are the "mavens," the enthusiastic few who are the early adopters of a new behavior, idea, or product. Second, there are the "connectors," individuals who have the rare ability to link people, ideas, and opportunities into synergistic patterns. And, finally, there are the "salesmen," those who have the ability to "sell" ideas to those who remain unconvinced that a new idea is riskworthy.

Judging from the number of conferences, journals, and other publications on teaching and learning improvement, there appear to be plenty of instructional technology mavens. It is therefore interesting to wonder why the efforts of these risk-takers have not resulted in a technology-driven revolution in teaching and learning. Is it because their success stories are not being shared with others in generalizable ways? Is it because the "mavens" aren't in touch with the right "connectors" and "salesmen" who can help spread their message?

Or perhaps is it because the message of change just isn't sticky enough to incite the sort of revolution that is going to be necessary for real change to take place? In simplistic terms, is the proverbial "elevator pitch" from a technology maven, connector, or even a salesman memorable or interesting enough to "stick" in the mind of a colleague? While the mavens are obviously enamored with their technological innovations, observers of the mavens might simply fail to "get" what the mavens are doing or understand the inherent value in those activities. Over and over, scholarly research on the impact of such innovations shows "no significant difference" between using traditional methods and new technologies. For example, this phenomenon is the subject of a Website that documents the findings of "no significant differences" (NSD) in student outcomes between alternate modes of education delivery (Russell, 2008). What is there in this message to motivate non-consumers to implement technology in their courses? Apparently not much. Most teachers are likely to perceive the costs (particularly in terms of their time) of producing and distributing technology-enhanced curricular materials to be higher than the perceived payoff.

In addition to these barriers, the current education context itself might not be conducive to a teaching and learning revolution. The reward (and punishment) structures and mores for teachers tend to promote caution and *satisficing* rather than experimentation and innovation in teaching and learning. Moreover, the costs of producing, delivering, and consuming new curricular materials enabled by new technologies might simply be too high. As a result, perceptions are often more important than reality when it comes to the context being right or wrong for a tipping point. For example, when lots of windows are broken in a neighborhood, a perception of disorder and lawlessness can trigger a crime epidemic. Gladwell maintains that human beings are "exquisitely sensitive" to such contextual changes (p. 140). Thus, the right change, albeit microscopic, can be enough to cause a tip which results in dramatic transformations. We are left wondering about the educational environment or context in which teachers, learners, and leaders think about and implement technology. Are there contextual factors holding us back?

Transformation and Context

While we are just as anxious as any of our readers to discover what might bring about a much-awaited tipping point in educational technology, it is crucial to recognize that an important first step is to proactively create a context more conducive to the sort of dramatic changes that can yield improvements of the 2-sigma magnitude. For starters, teaching and learning tools and content must be made more available, affordable, and usable than they are today. That means it is not sufficient to merely create technologies that are capable of facilitating learning. In addition, such technologies have to be effectively and efficiently deliverable to ALL learners.

Compared to the pace of what some call "Internet Time," the implementation and transformational impact of educational technology might seem painfully slow. A look to the past is instructive. Other revolutionary learning technologies have had to overcome many of the same challenges as today's new educational technologies. For example, it is hard to imagine a "technology" more revolutionary than writing. But writing was not universally embraced by the intellectuals and teachers of the day. Socrates himself, speaking through the voice of Thamus, the king of Egypt, bemoaned:

> The specific which you have discovered is an aid not to memory, but to reminiscence, and you give your disciples not truth, but only the semblance of truth; they will be hearers of many things and will have learned nothing; they will appear to be omniscient and will generally know nothing; they will be tiresome company, having the show of wisdom without the reality. (Plato, 370 B.C.)

With luminaries of such stature lamenting the invention of something as fundamental as writing, it is abundantly clear that human beings have always been conservative and resistant to "technological" change.

Although such resistance to change limited the impact of writing on average people for centuries, even after the invention of movable type in the Western World, basic human conservatism was not the only factor that hindered its adoption. As with any technological revolution, changes in how things were done—changes in context—were just as necessary for the broad emergence and use of books, as illustrated by the following story imagined by the French videodisc pioneer, Georges Broussaud:

> King Charles VII of France wanted to learn of the high technology recently invented by Gutenberg, so he sent his emissary on a fact-finding trip. The emissary returned several months later to report on what he had found. "Well," said the King, "What do you think of this new, high-tech stuff called movable type?" "Interesting," replied the emissary. "Only interesting?" said the King. "Yes, Sire. It is very interesting indeed, but it is going nowhere," said the Emissary. "Why on Earth not? If it is interesting, why isn't it going anywhere?" exclaimed the King. Replied the Emissary, "First of all there is no distribution channel, no way to insure the sale of the books that would be printed. Finally, Sire, people can't read!" (Bush, 1989, p. 11)

What eventually happened, of course, was not far removed from this story. While it is said that Gutenberg's invention took place sometime between 1440 and 1455, it was not until the early 1500s that book shops became more widely available, and then only in the larger cities. In order for writing in this form to move beyond expensive, hand-copied volumes chained to the lecterns of the Sorbonne from which lectures were delivered ("lecture" in French is quite literally "reading"), fundamental changes were necessary. Although technological improvements were certainly essential, the widespread implementation of books did not happen until attitudes and expectations were also changed.

Taken together, this means that writing did not reach its "tipping point" until key contextual factors changed, i.e., it became widely available, affordable, and usable. These are common contextual necessities that influence the adoption and accessibility of any particular innovation. For example, one of the most important changes in context that served as impetus for making writing technology more accessible to the average man or woman was a growing democratic demand for access to more and more content. The people wanted—even demanded—the ability to read what the elites were reading (Graff, 1991, p. 113). Only then did the organizations (primarily religious ones) that determined how writing technology would be used become predisposed to its broader implementation. Note that necessary changes in roles and organizational structures *followed* the tipping point in this instance—they did not precede it. Such will likely be the case for today's digitally-based educational technology. Similarly today, as the democratic demand for access to more and more learning content and learning opportunities grows, the context will become ripe for a transformation of teaching and learning.

A Principle-Driven Approach to Technology in Education

The history of the coming of books onward from the Fifteenth Century provides numerous lessons for understanding the various changes that must take place before new learning technologies can have their predicted impact and bring about an associated shift in its focus from teaching to learning. Even in today's Twenty-First Century, writing and printing combine to form the most prevalent educational technology in use today—books—which continue to bridge time and space, unsurpassed in many ways in their ability to disseminate knowledge and learning.

Just as was the case for books in Western Europe, the transformation of teaching and learning in education today certainly depends on the effective implementation of the right technologies. But it does NOT depend on implementing the same kinds of technologies in the same ways they have been done for the past 30 years, the past 20 years, the past decade, or even the last five years. To achieve the dramatically different results (on the 2-sigma scale) the educational community has longed for, innovators cannot persist in pursuing the same strategies that have failed for decades to yield the desired results. Instead, the only viable approach is to change the rules of the game, fundamentally altering the environment in which learning occurs. Particular technologies and technology standards are certainly part of the equation; however, no technology or standard has value in and of itself. Value comes from what is done through the implementation of those standards in the creation and use of effective and affordable learning materials.

This need to change the rules of the game was as true in the past as it is today. Printing has made learning increasingly available for nearly 600 years. The resulting transformation provides insights that can guide the implementation of technology that might challenge the pre-eminent position still held by printing and the classrooms in which it is used. These insights can be subsumed into three core principles of design that must be at the center of our discussions, debates, strategic planning, and then our implementations and integrations of teaching and learning technology: (1) learner-centricity, (2) content and tool malleability (which encompasses openness, modularity, and interoperability), and (3) the network effect.

Learner-Centricity: Changing the Focus from Teaching to Learning

If the educational establishment is likely to follow rather than lead the next educational technology revolution, from where will the energy of the revolution come? Who will create the context for a dramatic transformation of teaching and learning facilitated by new technologies? As was the case for the writing revolution, the energy is most likely to come from the masses. Despite the claim by some that a technology-driven transformation of learning is *about* to happen, there is already evidence that (1) technology use in education has increased to remarkable levels, and (2) there are many incredible educational applications in use that were never foreseen in the crystal balls of even the most visionary of scholars of years past. The more pertinent question might be: when will these technologies begin transforming the education establishment?

Perhaps soon. The authors of *Disrupting Class: How Disruptive Innovation Will Change the Way the World Learns* assert that we are rapidly approaching a tipping point in the delivery of online learning. They predict that "given the current trajectory of substitution, about 80 percent of courses taken in 2024 will have been taught online in a student-centric way" (Christensen, Horn, & Johnson, 2008, p. 102).[i] This dramatic change will be driven in large part by learners as they increasingly demand the kinds of courses they need and want in their efforts to accomplish their educational goals. Although the authors' investigation and arguments focus primarily on K–12, similar conclusions can easily be drawn for K–16, or perhaps even for K–20.

To raise the issue of student demand here is to take a calculated risk. For many, taking student demand into consideration is antithetical to the philosophy of education itself, probably at any level. According to this prevailing (but waning?) view, professors and teachers and administrators are the founts of knowledge and wisdom when it comes to deciding what students should learn, when it should be learned, and in what order. To cater to student demand, subscribers of this view argue, would be to water down and diminish the value of school-based education, essentially allowing the inmates to run the asylum.

Several key assumptions about quality educational technology, however, countervail against such a world view and guide the conclusions of this article. These are provided not as evidence of universal consensus but for the sake of discussion:

1. Educational technology can and should be used to facilitate the:
   a. definition and publication of student learning outcomes;
   b. design of the curriculum necessary to help achieve those outcomes; and
   c. delivery of the curriculum that must be developed.
2. The capacity of educational technology (both in terms of hardware and software) for individualized learner support exceeds in many ways what was imagined at the dawn of computer-based learning.
3. Educational technology can facilitate a wide variety of learning experiences for a global, distributed audience of learners.
4. Educational technology need not be implemented in a monolithic, standardized, "enterprise" fashion to be effective or efficient. Nor must the same tools be used to facilitate every course (or learning experience) by every instructor and every learner.
5. Educational technology can be successfully implemented to meet the diverse needs and circumstances of learners in a variety of contexts, e.g., traditional class-based learning enhanced with technology, hybrid courses that are part traditional/part-online, synchronous online courses, asynchronous online courses, informal (non-class) learning experiences, etc.
6. Educational technology allows, and perhaps requires, learners to adopt new attitudes, self-perceptions, and roles.
7. Just as the implementation of educational technology causes students to change how they think, act, and feel as they learn, so must teachers and educational support staff change how they approach their responsibilities.

Implicit in all of these assumptions is a clear emphasis on the needs of the individual learner. What the learner needs—and even wants—is an increasingly important variable in the design and delivery of learning opportunities. Accordingly, the educational system should refocus its technology resources and efforts at least as much on learners as it has on institutions and teachers in the past. As Christensen *et al.* (2008) have argued, learner demand for a broader variety of learning experiences will continue to drive "disruptive innovation" in education.

How should teaching and learning administrators and strategic planners respond to these demands? For starters, educational technologists need to begin thinking differently about the effectiveness of teaching and learning technology. The goals we articulate at the outset invariably drive our technology strategies, tactics, and results. Scholarly trends like the Design-Based Research movement and practical efforts like Carol Twigg's National Center for Academic Transformation *(http://www.center.rpi.edu)* are examples of the new approach we have in mind. A related philosophical challenge is to change our mindset of learning *from* technology to learning *with* technology (Reeves, 2006). Until reformers and practitioners begin talking and thinking about how teachers and learners can use technology—to work with it—to transform and dramatically improve teaching and learning, we'll be stuck with the "old wine in new bottles" that Cuban lamented in his study of education in Silicon Valley. And instead of responding to student demand for better and more flexible learning opportunities, we'll continue to respond to institutional and instructor demands for more efficiency and convenience.

As educational systems focus on student demand, the supply of quality, flexible teaching and learning content and tools will increase dramatically. Unfortunately, the market will not naturally or automatically make this adjustment as a service to would-be reformers, because students are not the direct customer of teaching and learning technologies—institutions and teachers are. Rather, we predict that as reformers shift their focus from teaching to learning, they will foment a revolution in technology that will dramatically improve learning outcomes. Not only will learning effectiveness increase, but a concomitant upsurge in learner engagement and satisfaction will become inevitable (Bourne & Moore, 2003).

Learners themselves will further catalyze this trend as they become more engaged in and assume greater personal responsibility for their own learning. Such developments depend very much on learner motivation, an often underestimated and inadequately tapped source of learning improvement. Roger Schank has argued that intrinsic motivation is the single most important contributor to student learning. In a recent talk at Brigham Young University, Schank showed a video of his grandson learning to crawl, asserting that you can learn all you need to know about learning by watching this event unfold (Schank, 2008). Because intrinsic motivation is monumentally important to the child's success, the role of the "teacher" in that particular learning context is not to explain the mechanics of crawling or even to model crawling for the child. The "teacher" (the grandfather in this case) merely placed a toy within a short crawling distance, prompting the child to make more progress in crawling in the short minutes that followed than he had achieved over the days that preceded this single learning experience.

The teacher's job, therefore, should increasingly be to enhance and leverage the learner's motivation by manipulating the environment, e.g., by placing desirable and achievable goals just out of reach, to create the ideal conditions for learning. Unfortunately, most of the educational experiences afforded to students in formal K–20 courses and classrooms rely on extrinsic motivation—grades, teacher, or peer pressure, etc. Consequently, the majority of the learning experiences that most students have during their formal careers as students are not the authentic, life-enhancing, enduring kinds of events idealized by innovators in their loftiest accounts of education. By shifting the focus in teaching and learning technology efforts away from institutions and teachers, moving it instead to learners, perhaps innovators can begin creating and providing more intrinsically motivating learning experiences to more learners.

As illustrated by the message conveyed to the king's emissary, those who will benefit from an innovation must be predisposed to the new technology's features in order for it to be usable. For books, this meant the masses had to be literate, a feat that took about 400 years! In England, for example, about two centuries after the invention of printing, two-thirds of adult males in areas close to London were illiterate, and it took another two hundred years for the proportion to be reversed in the country as a whole (Lane, 1980).

The applicability of the innovation to the needs of its users is no different today than it was during the dawn of the technology of books. Indeed, the most important principle impinging on the effectiveness of any technology has less to do with the technology itself than it does with its ability to address the capabilities and needs of the learner. Not only must learners be able to use the innovation, but its features must be focused on promoting useful outcomes that will benefit the learners. Furthermore, the learning outcomes of the future should not necessarily remain those of the past. As summarized by the noted pioneer in computer-based learning, Alfred Bork, "Memory is no longer important. Solving problems, encouraging creativity, adapting to change, and building intuition take priority" (Bork, 2000, p. 79).

If technology resources and efforts are not first-and-foremost focused on learning, it will matter very little how technically sophisticated and elegant they are. Indeed, some very thoughtful educational technology "solutions," such as Columbia's Fathom[ii] (Hane, 2003; Wilson, 2003) and the University of Illinois' Global Campus, have failed to meet their stated goal of expanding educational opportunities, most likely because they did not align with student needs and, hence, were not financially viable. The University of Illinois' launched Global Campus in January 2008 with a price tag of $8.9 million ("Hopes," 2008), but the program achieved lower enrollments and fewer available courses than had been anticipated.

In their groundbreaking article "From Teaching to Learning," Barr and Tagg asserted that "subtly but profoundly" a shift was taking place in American higher education away from the view that "A college is an institution that exists to provide instruction" to the view that "A college is an institution that exists to produce learning" (1995, p. 13). The authors readily admitted that the sort of change they were describing would require significant role and cultural changes within higher education. With specific regard to technology, they observed:

> In the Learning Paradigm, as colleges specify learning goals and focus on learning technologies, interdisciplinary (or non-disciplinary) task groups and design teams become a major operating mode. For example, faculty may form a design team to develop a learning experience in which students networked via computers learn to write about selected texts or on a particular theme.… After developing and testing its new learning module, the design team may even be able to let students proceed through it without direct faculty contact except at designated points. (p. 24)

Some colleges and universities have undergone significant transformations (in many cases as they have been compelled to by the accreditation process) from teaching-focused to learning-focused curriculum design, delivery, and evaluation processes. Corresponding changes in the way technology is used to support teaching and learning have been slower to materialize, however, perhaps because the accreditation bodies have not required such changes. Even more important is the reality that the financial and cultural incentives of educational technology support organizations at colleges and universities drive them to implement technologies that improve institutional and teaching-focused efficiencies rather than improve learning itself.

To realize Barr and Tagg's vision of a more learning-centered academy, which will help begin closing the 2-sigma gap, educators will need to be much more learning-focused in the development, implementation, and evaluation of learning technology. An important first step is to begin thinking about tools from the learner's perspective and the tasks learners perform. Accordingly, it is important to think about necessary changes in the roles of faculty and administrators as they become more focused on facilitating learning than on delivering instructional content. Additionally, more attention should be focused on technologies that help students manage their own educational careers, perhaps over long (i.e., non-traditional, disrupted) periods of time and perhaps at multiple institutions of learning.

Technology, by itself, is not the answer. Indeed, in his more recent book, *The Learning Paradigm College*, Tagg warns that technology can be used just as effectively to reinforce a teaching-centered college as it can be to foster a new learning-centered environment (2003, p. 332). Learning-centered technology implementations, he argues, should:

- focus on learning rather than teaching activities and performances;
- reinforce effective learning habits and skills (e.g. persuasive writing) taught elsewhere;
- provide ample, appropriate, and timely scaffolding during the learning process;
- deliver rapid, effective feedback on student performance; and
- facilitate and reinforce communities of "practice" or learning. (pp. 333–334)

In all of this, successful innovators will avoid limiting the influence and impact of these technologies to the boundaries of the traditional classroom. To the extent feasible, these technologies should be used to "extend the students' reach beyond a single learning environment" (2003, p. 334).

In a learner-centered model, learners are required to take greater personal responsibility for their own learning, changing the focus of education from the authority figures of education to the student as learner (Bork, 2000). For this to be possible, institutions should provide learners with tools that allow them to claim ownership and control over their own learning content and the relationships they establish in the learning process. Increasingly, learners can utilize freely available tools (e.g., blogs, social bookmarking sites, Google Docs, etc.) to create and manage their own learning experiences. This functionality enables so-called "personal learning environments" or PLEs[iii] that are becoming increasingly important features of the teaching and learning technology landscape. Teachers at all levels are likewise taking advantage of such tools that allow them to be more effective mentors, coaches, and learning facilitators. Institutions need to consider ways they can leverage such tools as they perform their unique roles as learning brokers that grant credentials and certify learner competencies.

Achieving Content and Tool Malleability Through Openness, Modularity, and Interoperability

The sort of paradigm shift described above represents change in the educational enterprise to a degree rarely seen in any human endeavor, much less in education, and especially over what needs to be a relatively short period of time. In order to sufficiently shift the focus from teaching to learning to the extent that would be required by the universal educational model practiced in developed countries today, educators will have to move into unknown and uncharted territory.

Such a shift is comparable on some level to what happened at IBM in 1980, when the company developed, produced, and distributed their first personal computer, from the decision to proceed through initial delivery, all in just over a year's time. To accomplish such a feat, the company assigned a small group of engineers to undertake the design of the system and to carry out the necessary implementation plan. Their success defied all expectations both within and without the company. At its outset, one external analyst evaluated the probability of success in such an endeavor: "IBM bringing out a personal computer would be like teaching an elephant to tap dance" ("The birth," n.d., para. 3). Some readers might find the analogy apt when thinking about the probability of getting educational institutions to fundamentally refocus their energies on student learning.

Nevertheless, building a personal computer was exactly what they did, and at a pace never before seen for other projects in the company. IBM describes the venture in these terms:

> In sum, the development team broke all the rules. They went outside the traditional boundaries of product development within IBM. They went to outside vendors for most of the parts, went to outside software developers for the operating system and application software, and acted as an independent business unit. ("The birth," n.d., para. 9)

The specific and ultimately successful implementation of the principles of modularity and interoperability in that process enabled IBM to call on outside vendors for parts for their personal computer. Their rejection of proprietary technology in favor of openness created the opportunity for IBM to call on Microsoft to develop the operating system and for a host of other companies (including Microsoft!) to go on to create thousands upon thousands of software applications, guaranteeing the long-term success of IBM's initial design. Furthermore, competing companies that chose a proprietary and closed approach for their hardware, software, or both, (e.g., Texas Instruments, Amiga, Atari, Commodore, and Radio Shack) are nowhere to be found among Twenty-First Century personal computers. Even Apple, with the initial version of their innovative Macintosh, came close to meeting disaster until they opened things up with their Macintosh II (Bush, 1996). In the end, the nature of IBM's approach not only ensured success in their initial venture, but the continued application of the same principles over the years by IBM's successors also makes it possible for today's machines to run much of the same software that was created for the original IBM PC.

Among the principles of openness, modularity, and interoperability that brought success to the IBM-PC venture, the importance of modularity seems perhaps preeminent and has been documented in detail by scholars at the Harvard Business School (Baldwin & Clark, 2000). In their initial work, they analyzed how modularity evolved as a set of design principles during the period between 1944 and 1960. Then using Holland's theory of complex adaptive systems as a theoretical foundation, they explain how the design principles they identified went on to radically transform the information technology industry from the 1960s through the end of the century. They show how modular design and design processes have fostered change in the industry as it moved from one consisting of a few dozen companies and dominated by IBM to one that involves over a thousand companies and in which IBM plays a significantly lesser role. For example, the "packaged software" sector in the information technology industry consisted of about seven firms in 1970 that were valued at just over $1 billion (as measured in constant 2002 dollars). Thirty-two years later that sector had grown to 408 companies with a market capitalization of $490 billion (Baldwin & Clark, 2006).

Unfortunately, the application of the principles that made such developments possible in the computer industry is rare to nonexistent in many areas of education today. The education technology landscape is best characterized by monolithic, enterprise technology silos with rigid, often impenetrable walls. Course management systems (CMSs), for example, are generally "all-or-nothing" propositions for institutions, teachers, and students. That is, even if you use an open source CMS like Moodle, you are (without significant customization) bound to use Moodle's content publishing tool, Moodle's quiz tool, Moodle's gradebook, etc. Moreover, the CMS paradigm itself, tied as it is to semester calendars and time-bounded learning experiences (courses), severely limits learning continuity and persistence. Teachers and students are not free to choose the right / best / preferred tool for each teaching or learning activity they undertake, thus creating a technology paradigm that artificially limits possibilities and forecloses optimal teaching and learning choices.

The monolithic and rigid nature of today's learning tools and content mirrors the way content has traditionally been made available to faculty and students—books and other resources (including online courses) have generally been all-or-nothing, take-them-or-leave-them propositions. A similar business model was prevalent in pre-Internet days, resulting in CD-ROM databases that were more expensive than many potential consumers could afford. One analysis compared this marketing approach to a public water distribution system that would require selling the whole reservoir to each household rather than placing a meter at individual homes.

New approaches to content distribution, however, particularly the OpenCourseWare (OCW) and Open Educational Resource (OER) movements, promise to make a vast array of content open to instructors and students to reuse, revise, remix, and redistribute. The OCW Consortium, beginning with MIT in 2002, has now grown to include hundreds of institutions around the world that have chosen to place course materials online.[iv] The efforts of these institutions have spawned a related effort, dubbed Open Educational Resources (OER), to make learning materials and content (as opposed to complete courses) freely available as well (Breck, 2007). Around the world, millions of people, inside and outside of academia, are publishing content under Creative Commons licensing, making that content open for others to use in a variety of ways. We are rapidly approaching the tipping point at which a critical mass of participants in open content and open learning is sufficient to exponentially increase the value of each additional participant in the network (as described in the next section).

The stunning reality of the new standard of openness is that it is quite simple. The key is to create lots and lots of open content and provide open, easy access to it. While technical standards and specifications, such as the Shareable Content Object Reference Model (SCORM), are important when it comes to producing indexing, discovering, sequencing, packaging, and tracking of content, openness by itself is a paradigm-shifting approach in the teaching and learning world. The fact that content is openly available and usable is just as important as any particular technical feature of that content.

While openness stands by itself as a radical new innovation, we need to avoid the temptation to downplay the importance of standards and specifications, for they are essential to the realization of the vision of open, modular, and interoperable learning environments. This reality is not without historical precedent. Printing became affordable and available in large part due to what we today call standards. Indeed, as one scholar declared, "This then—the standardization and rapid multiplication of texts—was what the fifteenth-century invention of printing made possible" (Bühler, 1952). Bühler also pointed out that printing's contributions went beyond the replication issue, stating that modern scholarship only became possible with the production of identical copies of texts. Although the value of mass duplication is not to be discounted, the fact that scholars could reference each other's work represented enormous value. Given this standardization, they were thus able to criticize, comment upon, connect to, and build upon what had come before. In many ways, printing standards facilitated the first widespread appearance of mashups in human history.

The existence of identical copies was but one characteristic that facilitated the eventual widespread availability of books. In addition, several other factors contributed to the production process itself, eventually increasing the opportunity for wider distribution. Characteristics such as the size of paper, the size of fonts, the number of lines per page, the viscosity and drying characteristics of ink, all worked together to make printing a viable technology. Without standard formats and formulations for each of these elements of the printing enterprise, efficient specialization and a resulting effective division of labor would not have been possible. There was no way that printers could have done their job well enough to be successful, had they been required to continue as machinist, metallurgist, and chemist.

The end result of the revolution in printing through the implementation of moveable type and associated technologies was a drastic reduction in the cost of books. In the same vein, there is little doubt that development costs for online materials are a problem. For example, one publication speculated that the president of the University of Illinois had seriously "underestimated the amount of effort it takes to create online courses" ("Hopes," 2008, para. 5) for their Global Campus project.

Parallels for standardization exist between what happened for books and what might happen with today's learning technologies and can be divided into two categories: (1) methodologies for producing the needed content, and (2) technologies for delivering and consuming the content. Success in carrying out each of these aspects of the problem depends on the availability of standard approaches to the activities of the teaching and learning enterprise as a whole.

The current state of the art for conducting each of these categories of activities in a standard way is embodied in several efforts currently underway in various quarters around the world. Some of that work involves the formulation of the concept commonly referred to as "learning objects" or "instructional" objects (Gibbons, Nelson, & Richards, 2000). The means of creating and using these learning objects in standard ways has been the goal of the Advanced Distributed Learning Initiative (ADL),[v] which seeks to "make learning accessible at anytime, anywhere in the world" (Fletcher, Tobias, & Wisher, 2007). To these ends, ADL has worked with numerous partners for about ten years in the development of SCORM, considered also to be essential for reducing life-cycle costs for online learning. Three additional and important efforts are also underway and to some extent in parallel: Common Cartridge, the Schools Interoperability Framework (SIF),[vi] and the International Federation for Learning, Education, and Training Systems Interoperability (LETSI).[vii]

SCORM, the common thread that connects each of these efforts to the others, is "a collection of standards and specifications adapted from multiple sources to provide a comprehensive suite of e-learning capabilities that enable interoperability, accessibility and reusability of Web-based learning content" ("SCORM," n.d.). The existence of 165 SCORM-conformant learning management systems in more than a dozen countries illustrates the broad and deep impact that SCORM is having in addressing interoperability problems in military, government, corporate training, higher education, and K–12 settings (Ellis, 2008).[viii]

Common Cartridge is a specification that has been formulated by the Common Cartridge Alliance[ix] in partnership with the IMS Global Learning Consortium. A group of developers representing a wide variety of organizations (several academic institutions, school districts, governmental organizations, and representatives of various commercial firms) have banded together to increase the interoperability of online learning content and tools. Rob Abel, the CEO of the IMS Global Learning Consortium, has explained (2007) that Common Cartridge does not replace SCORM, indeed it incorporates SCORM and addresses what the partners in the alliance felt were various shortcomings of SCORM as well as a very different need than SCORM. Specifically, it was "designed for online support of all forms of teaching and learning" where "SCORM was designed for self-paced computer-based training" (Abel, 2007, p. 7).

The purpose of the Schools Interoperability Framework (SIF) is to promote standards for data exchange among all educational software applications in the K–12 setting, including instructional, administrative, and infrastructure functions. SIF works on a "collaboratively defined data model" (SCORM & SIF, 2006) and implements a Web service under a Service-Oriented Architecture (Abbott, Canada, Fawcett, & Nadeau, 2008). In August 2008, the SIF Association and ADL entered into a pilot project to facilitate:

(1) passing digital content from a publisher to a learning platform;
(2) passing shareable content object (SCO) data, regardless the state, from one application to another in real-time; and
(3) providing a more comprehensive approach for interoperability within the school's environment by leveraging and utilizing SIF and SCORM data objects together (Abbott, 2008).

The work by SIF not only illustrates the complexity of the information technology problem that educators and administrators face but it also provides a model for how numerous and disparate software applications can work together to facilitate the delivery and consumption of educational content. If software can interoperate in addressing the complexities of school operation, the creation of the means for systems to work together in the design, development, and delivery of learning materials should also be possible.

SCORM, currently in Edition 3 of SCORM 2004, represents the most substantial work in this arena (Fletcher, Tobias, & Wisher, 2007). Although more changes are possible under the aegis of ADL, future substantial developments and stewardship have been delegated to LETSI. The new organization inaugurated its SCORM 2.0 efforts at a recent meeting in Pensacola, Florida. Over 60 representatives from "government, industry, military, academia, K–12 schools, and the medical community from the United States, Canada, Australia, the United Kingdom, Germany, Korea, Singapore, and Japan" (Richards, 2008, p. 1) met to discuss almost 100 white papers submitted for consideration.[x] Preparations during the run-up to the meeting in Pensacola and the sessions there established four working groups:

- Architecture
- Business Requirements
- Sequencing
- Teaching and Learning Strategies

The purpose of the LETSI effort is to take SCORM to the next level by addressing issues that the community has raised with previous versions and updating its fundamental architectures as well as to broaden stewardship for its development. The first source of potential impact on products and practice will come with the release of "a 'Design Document' for SCORM 2.0, which will basically outline what SCORM 2.0 will be" (Ellis, 2008, para.10). The final version of the specification will come later, but this first document will enable stakeholders to begin planning their future product releases. Initial developments indicate that the new version will implement Web services, the foundation of future interoperability on the Internet.

The primary difference between the objectives of LETSI and SCORM is one of focus. Where the first versions of SCORM targeted what became known as the "ilities" (Accessibility, Interoperability, Durability, and Reusability) (Bush, 2002), SCORM 2.0 will focus mainly on interoperability, as indicated by the name LETSI itself. Organizers are basing this narrowed emphasis on the supposition that the other benefits will follow naturally once interoperability is attained.

Despite its wide impact, SCORM has not been without its detractors. Some have felt that the specification was more the product of software engineers rather than instructional designers. Reaction to such concerns has been the subject of several symposia[xi] at Brigham Young University (ID+SCORM). These events have been aimed at bringing together the various disparate views on the topic (Bush, 2002). They have, in turn, raised yet additional issues.

For example, some people have believed that SCORM is only about metadata (Bush, 2002) or about the challenges of reusability (Downes, 2003). Others complain that the requirements for the size of learning objects are so vague as to make the concept meaningless, describing them as "a drop in the ocean or the ocean itself" (Bush, 2002, p. 10). This lack of definition has prompted theorists and developers to seek to better define the granularity of learning objects (Thompson & Yonekura, 2005; Wiley, Gibbons, & Recker, 2000).

A lack of understanding of SCORM and a clear understanding of its purposes are often responsible for many of the objections that are raised. For example, Romizowski has written that metadata defines the characteristics of a learning object and "facilitates its identification, classification, localization, and reutilization (defining this is what standards like SCORM are all about)" (2009, p. 57). Although the notion of metadata has often dominated information that has been distributed about SCORM, being able to describe learning objects for their ultimate distribution and reuse is but one aspect of the goals of the specification. To say that using metadata to define the characteristics of a learning object is "what standards like SCORM are all about" is like saying that card catalogs are what libraries are all about. Card catalogs and metadata are both important and contribute to the usefulness of the content to which they refer, but it is the content or its purpose that should be the focus in each case. The organizers of LETSI are hoping that their emphasis on interoperability for SCORM 2.0 will help to correct such misunderstandings.

A summary of the proceedings of the first ID+SCORM meeting at BYU along with a detailed discussion of the justification for standards appeared in a 2002 *Educational Technology* article (Bush, 2002). Reacting to this overview and the general state of SCORM, one expert stated that "in order to use a learning design with a set of objects, the learning design must specify the objects to be used, and if the objects to be used are specified, then the learning design is not reusable" (Downes, 2003, p. 1). His rejection/criticism of SCORM concluded with this observation: "Learning design and reusability are incompatible" (Downes, 2003, p. 7).

Romiszowski (2007) revisited some of Downes' comments, wondering whether SCORM would live or die. He observed that none of the presentations at the early iterations of ID+SCORM had discussed "return-on-investment or cost-benefit," given that "one of the main motivating factors for the birth of interest in design of reusable learning objects, creation of a learning objects economy, and indeed the invention of standards such as SCORM, is to rationalize the work involved in development of new courses, by avoiding unnecessary rework and the continual 'reinvention of wheels'—all this in the name of reduced costs and increased efficiency" (Romiszowski, 2007, p. 62). Reuse, he feared, could well "run aground like so many other technology-driven initiatives on the unpredictable shoals of human nature and organizational behavior" (Romiszowski, 2007, p. 62). Providing concrete examples from his own experience, he described projects that were heavily influenced by specific, local problems that caused the developers to create their own specific materials rather than rely on the materials developed in other settings.

These objections raised by Downes and by Romiszowski are not without merit. Yet there are various counterarguments to be made in both cases. Most important is the fact that just because reuse is not always possible does not mean that it is always *impossible*. In fact, although a learning object that is useful in one context, say at one institution, might be unusable in numerous other settings, it is also possible that this same learning object *could be* exactly what is needed elsewhere.

Not only is this true across numerous institutions, it might well be true across departments within the same school or university. For example, courses that provide an introduction to statistics are frequently taught in several departments on a single campus. This duplication is typically justified because the examples used by a professor in the Department of Statistics will not be the same as those used in a course taught in the Business School or in the School of Education. Nevertheless, all of these courses will contain units on statistical principles such as say, Student's *t* distribution, which could well have application in other courses. Why should every statistics course at a single university or on every other campus use a different learning object to present such fundamental concepts?

Reuse can exist at several levels. Although Downes (2003) argues that the reuse of instructional design is *by definition* not plausible, he would be hard pressed to argue that assets used in learning objects cannot be used in multiple settings. Whether they be maps, digital audio or video recordings of significant events, pictures, or animations, reuse at this level of granularity is not only possible but desirable.

Unfortunately, this is one area where previous and existing versions of SCORM have been lacking. Each instance of use of a particular digital asset has required that the asset be contained within a self-contained package (typically a ZIP file) for the learning object that uses the asset. The standards and specifications that follow SCORM will succeed at least partially to the extent that they can address such shortcomings.

Although SCORM is not perfect, it at least began to address the issue of establishing a framework within which learning content can be made to interoperate in a variety of settings. Just as SIF opens up the opportunity for reuse of information created and used by various operational elements of schools, SCORM still holds the promise to facilitate the sharing of learning content, not only across learning management systems but also across tools that facilitate the design and development of learning content. In addition, common authentication schemes (e.g., OpenID) built upon Web services interoperability will ultimately allow learners to seamlessly navigate multiple Web-based teaching and learning applications, opening up possibilities for personal learning environments in which multiple sources of content and experiences work together to help students learn in ways that are tailored to each individual.

With developments like SCORM 2.0 on the horizon, as well as increasingly powerful software, hardware, and networking tools, technological barriers are falling. The challenge now is to harness these new enabling technologies to create more open, modular, and interoperable learning content as well as production and learning tools that are each malleable with respect to their individual functionality. Together, these technologies will help further the transformation of education from a teaching-oriented enterprise to a learning-centered one.

The Power of the Network Effect

Creating an optimal level of content and tool malleability opens many new production contexts that in turn open various learning contexts to the benefits of the "network effect." Metcalfe's Law holds that the value of the network "is proportional to the square of the number of users of the system" *(http://en.wikipedia.org/wiki/Metcalfe's_law)*. Stated another way, value accrues to the system as a whole because the more users or "nodes" there are in a network, the more possible connections there are. As illustrated in ***Figure 1***, a network of two phones would allow only one connection from each phone to another phone, while a network of five phones allows for ten unique connections and a network with 12 phones allows for 66 connections. As the number of nodes increases, the magnitude of the network effect grows exponentially, as detailed in ***Table 1***.

The power of the network effect is not limited to hardware-based communications networks. Metcalfe's Law is equally applicable to human networks, facilitated today more powerfully and efficiently than ever before via social networking technologies like YouTube, Wikipedia, and Flickr. With these enabling technologies, the network effect has dramatically transformed the way people interact. In *Wikinomics*, Tapscott and Williams declare that "deep changes in technology, demographics, business, the economy, and the world" have ushered in a "new age where people participate" like never before (2006, p. 10). Moreover, they contend that we have already reached a "tipping point where new forms of mass collaboration are changing how goods and services are invented, produced, marketed, and distributed on a global basis." In *The Wisdom of Crowds*, Surowiecki explains that large groups of people can be "smart" when they are diverse, individuals in the group are independent from each other, and thought processes are decentralized (2004, p. 42). Another view of so-called "crowdsourcing" suggests that humanity is now capable of "using the kind of collective intelligence once reserved for ants and bees—but now with human IQ driving the mix." What is the result? A "quantum increase in the world's ability to conceive, create, compute, and connect. We are only beginning to comprehend the consequences" (Libert, Spector, & Tapscott, 2007, p. 1).

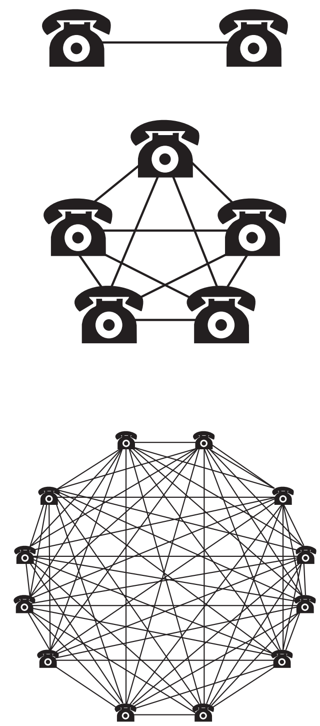

Figure 1. The Network Effect. Source: Wikipedia.

New technologies allow virtually anyone to create and publish content globally. Even more impactful is the fact that such content creation and dissemination can be done collaboratively. Multiple people can work together to author and refine materials. Still others can annotate, tag, remix, and redistribute that content. We're no longer solely dependent upon experts and information scientists to organize and make information available to us. As millions of people create, view, and tag content, rich folksonomies (taxonomies created dynamically by large numbers of people) are created dynamically, providing future pathways to and connections between content that will benefit future learners. As more and more people engage in such activities, the network effect will grow increasingly powerful and far-reaching in its implications for teaching and learning.

The emergence of a massive, human communication network has already begun to yield significant impact on education in far-reaching ways. Awareness and understanding of these changes among practitioners and scholars, however, lags behind reality. Surprisingly, Tapscott and Williams specifically mention education only four times in their 340-page volume on "wikinomics." The references themselves are also intriguing. The first is a mention of the MIT OpenCourseWare initiative (pp. 22–23). The second references TakingITGlobal's efforts to reform education by

Table 1. The Network Effect.

Nodes	Possible Connections
1	0
2	1
5	10
12	66
50	1,225
100	4,950
1,000	499,500
10,000	49,995,000
100,000	4,999,950,000
1,000,000	499,999,500,000

providing a "set of tools and curricular activities that will get students collaborating with other students in other countries" (p. 51). The third refers to the California Department of Education's Open Source Textbook Project (p. 69). And, the fourth, an additional mention of the California textbook project (p. 301). Note that only one of these references relates to the way students actually learn—the others are about content creation and distribution.

This is additional evidence that technology's real impact on education is yet to be realized. In a 2007 IRRODL article, David Annand observed: "Much like the Industrial Revolution before it, rapid technological change in the Information Age has to date created significant, fundamental change in virtually all sectors of society *except education*" (2007, p. 6, *emphasis added*).

One of the primary reasons technology has as yet failed to transform education is the failure of educational administrators and teachers to recognize the importance of and take advantage of the network effect on teaching and learning. New social networking technologies allow large groups of teachers and learners to create, moderate, and refine learning content. Other tools allow groups of learners across the globe to interact with each other in discussions, research debates, and in the creation of new knowledge. Institutions, administrators, instructional designers, teachers, and learners should work together to explore new ways to leverage these new possibilities. For example, the California Open Source Textbook Project and broader initiatives like OCW and OER are working (and will continue to work) because they involve very large numbers of teachers and learners who are creating and improving the content.

As more and more innovative ideas are implemented to take advantage of openness and the network effect, institutions must grapple with new questions regarding "original" content creation, content ownership, content quality, content distribution and availability, etc. One of the most important developments we foresee is the reallocation of energy and attention to leveraging the potential of large-group, collaborative dialogue and learning. Beyond open- and community-source curriculum, we should continue to pursue the development of open and community learning tools. Content and tools will become increasingly effective and utilized to the extent that they are also malleable, or in other words, open, modular, and interoperable.

Conclusion

Like the man on the park bench waiting for Godot, those who watch for dramatic improvements in learning facilitated by educational technology might wonder if that which they await will ever come. After decades of watching, we are still anticipating the long-predicted transformation of teaching and learning that closes the 2-sigma gap. These changes will not be realized until teaching and learning strategies focus less on the tactical implementation of specific technologies which often simply automate the past and focus instead on the broader, transformative principles of educational technology outlined above. Namely, transformation will come when we recognize and emphasize the importance of learner-centricity, content and tool malleability, and the network effect.

The history of the book and the PC, although separated significantly in time and space, remind us of the need for increased learner-centricity in the educational enterprise. On the one hand, Gutenberg's moveable type addressed individual learner needs by making books widely available for their individual use. On the other hand, the IBM PC helped usher in the era of personal computing and with it the potential of dealing with individual differences in learning. These technologies facilitated changes in focus from teaching to learning and helped place individual learners at the center of the learning enterprise.

Technological standards and content specifications stand side by side with the ideal of openness as critically important catalysts for the long-awaited transformation of teaching and learning that Bloom and others have predicted. But they will only matter to the extent that they are bolstered by the other principles we have outlined.

Specifications and developments such as the School Interoperability Framework (SIF), SCORM, and Common Cartridge have the potential to facilitate the effective creation, packaging, deployment, and tracking of learning content and activities in ways consistent with learner needs and learner achievement. These developments will succeed as standards or specifications, however, only after we have addressed content and tool malleability issues and are committed to interoperability (i.e., enabling content and tools to be deployable in any "system" and viewable on any device). The same things can be said of openness—open access to content only matters to the extent that content is learner-centric—is created in such a way that it can be reused, revised, remixed, and redistributed in an open, interoperable technology environment.

Such an educational landscape would enable the actualization of the developments predicted in *Wikinomics*, namely a world in which massive numbers of people participate in the production, delivery, and consumption of learning content with the highest possible production values. The amount of materials that are needed for truly universal education is large enough to demand the attention of billions of producer/consumers. But the tools and the resulting content will be useful and viable only to the extent that it is learner-centric and malleable. Likewise, the network effect can only have sway if teachers and learners are able to use the content and tools created by others. And the results of student use of these tools and content must not only be connected to teachers' grade books, but they must also be available for the evaluation and improvement of the materials.

We conclude by observing that the ideal teaching and learning ecosystem would allow the use of a wide variety of tools and content for a wide variety of purposes to facilitate effective, efficient, and timely learning. Teachers and learners ought to be able to use the best tools and content to match the particular learning goals, contexts, and challenges they face. In an authentically open, modular, and interoperable environment, tools and content would be seamlessly plug-and-playable, consistent with accepted technological, usability, and accessibility standards. The realization of such ideals is essential to the creation and perpetuation of effective PLEs that hold the potential to transform the way individual learners learn.

Again, if these conditions are met—which after all is the *raison d'être* of educational technology standards, content specifications, and the OCW and OER movements—we can, perhaps, finally realize the promised synergy between technical standards and specifications, openness, content and tool malleability, and the network effect. These forces might at last combine to produce a dramatic expansion and improvement of both the quality and quantity of educational opportunities. We might never have flying cars, but maybe we can finally start closing the 2-sigma gap. □

Notes

(i) Christensen *et al.* provide a view of the public education industry "through the lenses of the theories of disruptive innovation" (p. 10). These theories are based on 20 years of research by one of the authors and a colleague at the Harvard Business School who together coined the term "disruptive technologies" (Bower & Christensen, 1995) to explain how a revolutionary technology can radically change the status quo in a particular market sector. In *Disrupting Class* the authors apply these theories to explain how changes in education are imminent and far-reaching.

(ii) Although Fathom has not achieved the financial success its founders anticipated, it apparently has gained a new lease on life and is now a repository of "free content developed for Fathom by its member institutions." See: *http://www.fathom.com/* .

(iii) See: *http://en.wikipedia.org/wiki/History_of_personal_learning_environments* .

(iv) OpenCourseWare materials are not online "courses" in the traditional sense of the term. The course materials do not generally comprise all of the materials necessary to "take a course" from beginning to end. Rather, the materials in an OCW library for any particular course represent much of the core content, frequently without the critical connective tissue added by an instructor. Assessments and assignments are also generally not included in OCW materials.

(v) The Advanced Distributed Learning Network was formed in 1999 as an operation of the US Department of Defense with the following purpose as described on its Website:

ADL employs a structured, adaptive, collaborative effort between the public and private sectors to develop the standards, tools and learning content for the learning environment of the future. The vision of the ADL Initiative is to provide access to the highest-quality learning and performance aiding that can be tailored to individual needs and delivered cost-effectively, anytime and anywhere.

See: *http://www.adlnet.gov/about/index.aspx* .

(vi) The Schools Interoperability Framework (SIF) Association explains that the SIF "ensures that data systems work together and free up educators to do what they do best: teach." See: *http://www.sifinfo.org/* . It is comprehensive and promotes the interoperation of all aspects of the K–12 information technology infrastructure (typically disparate and from numerous vendors) through a Zone Integration Server. See: *http://www.sifinfo.org/upload/presentations/C2CCBE_SIFA%20ROI%202006.ppt* . The system architecture implements a Web service through a Service-Oriented Architecture. See: *http://www.sifinfo.org/upload/presentations/89FBED_SIF_CoSN_2008.pdf* .

(vii) The International Federation for Learning, Education, and Training Systems Interoperability (LETSI) was organized by several organizations, public and private, for the development of the next generation of SCORM, SCORM 2.0. Where the initial versions of SCORM have been developed by ADL, which is supported by the US Department of Defense, LETSI brings together organizations and individuals from around the world to collaborate on what SCORM will be in the future. See: *http://www.letsi.org* . Founding members included "12 sponsors comprised of standards organizations, government programs, and suppliers, such as the Masie Learning Consortium, MedBiquitous, Adobe, Aviation Industry Computer-Based Training Committee (AICC), and Schools Interoperability Framework Association (SIFA). International organizations also are sponsoring LETSI, including Korea Institute for Electronic Commerce (KIEC) and el Instituto Latinoamericano de la Comunicación Educativa (ILCE)" (Ellis, 2008, para. 6).

(viii) Several sources provide an overview and justification of SCORM (Bush, 2002; Godwin-Jones, 2004). Other sources identify some of the challenges to working with SCORM with the limited authoring tools that are available today (Gonzalez-Barbone & Anido-Rifon, 2008).

(ix) For an overview of the mission, goals, and membership of the Common Cartridge Alliance as well as links for additional information. See: *http://www.imsglobal.org/cc/alliance.html* .

(x) SCORM 2.0 White Papers, now number over 100 and are accessible at *http://www.letsi.org/display/nextscorm/SCORM+2.0+White+Papers* .

(xi) The first two iterations of the symposia occurred in 2002 and 2003 under the name ID2SCORM. Renamed ID+SCORM, the symposia once again took place in 2007 and 2008. Most of the presentations for ID+SCORM 2008 are available in the form of PowerPoint slides with audio at: *http://arclite.byu.edu/id+scorm/index.php?title=Presentations_2008* . Depending on the speed of developments for SCORM 2.0, a reprise could once again occur in 2010.

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Role-Based Design

A Contemporary Framework for Innovation and Creativity in Instructional Design

Brad Hokanson
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This is the first in a series of four articles presenting a new outlook on the process of instructional design. Along with offering an improvement to current practice, the goal is to stimulate discussion about the role of designers, and more importantly, about the nature of the process of instructional design. The authors present in this article a brief overview of current instructional design processes and an illustration of a contemporary framework for design created to foster innovation and creativity throughout the instructional design process.

Introduction

Current practice in instructional design is focused on generic descriptions of phases, rather than the nature of people and philosophical values (e.g., Hoadley & Cox, in press; Silber, 2007; Visscher-Voerman & Gustafson, 2004). Most design processes followed in the field are derivations of the same sequential models often referred to as "ADDIE"—Analysis, Design, Development, Implementation, Evaluation. These processes tend to concentrate on the completion of technological and pedagogical requirements rather than on the quality of the learning experience or innovation. We contend that much of the shortfall in advancing education with technology is due to a limiting design process that centers on *completing the work,* with only incremental increases in production and educational efficiency.

Although we do not necessarily share the unenthusiastic and somewhat pessimistic expectations about technology and education (Zemsky & Massy, 2004), we do believe that educational technology, as is currently used, would benefit from a substantial infusion of creative, innovative, and artistic ideas. Often restricted by rigorous and sequential design processes, the current practice of instructional design has experienced only limited improvement over the years. A change in process is needed from the early phases of conceptualization through the final steps of production and integration. This will require a reshaping of the processes and models of instructional design to challenge our philosophy and help shape our designs.

We propose the exploration of an idea that will help encourage substantial innovation in instructional design, a design process that focuses on context and design qualities, on aesthetics and creativity, and one which is based on the *roles* a designer must play, as part of a complete design process.

Design Processes, Methods, and Frameworks: A Brief Critique

Jonassen (2006) holds that instructional design is historically regarded as a linear series of steps and phases that constructs models and processes "based on principles that are applied uniformly to all contexts," leading to the conclusion explaining why "instructional design is so seldom successful" (p. 26). Ultimately, we agree. A design process that is linear, constrained, and separated from context is limited in its potential. In contrast, current educational theory urges new teachers to be holistic and creatively adjust to classroom and societal change; educational challenges are urged to be authentic and innovative. In parallel, our instructional design process should employ these same values: creativity, innovativeness, and authenticity, as well as an understanding of the contemporary research ideas of the field.

Our concern centers on defining how the work of design is addressed: Is the work one of dealing with well-structured problems, those that can be simply and convergently answered through an algorithm or codified process? Or, is the work of (instructional) design focused on divergent problems,* those that are ill-structured, or wicked problems which seek solutions, but have no single answer? We contend the problems of instructional design are complex and are not well addressed by simple algorithmic processes.

Algorithms are valuable in that they are step-by-step means of reaching generally reproducible results. They are codified means of production, and, we argue, this is the essence of ADDIE in the design process. ADDIE,

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*Ill-structured problems are those with unclear problem and solution states. Wicked problems are similarly defined but in addition are contentious, contextual, subjective, and completion-critical (Becker, 2007; Nelson & Stolterman 2003; Rittel & Webber, 1973; Simon, 1973).

like most other algorithms, seeks an anticipated solution, a single answer that all designers can achieve, and one which is context and participant independent.

Algorithms do have value in a knowledge-based society: Moldoveanu & Martin (2008) describe the modern use of algorithms as one reason, combined with technological computing, for the advances in late 20th century thought:

> The power of the algorithm lies precisely in the fact that it makes efficient the translation of knowledge into action. As knowledge structures progress in levels of precision and specificity, from pictures to heuristics to theories to models to algorithms, they also become more easily translatable into predictable, output oriented, behavioral patterns or routines. Not surprisingly, the development of algorithmic agents—both human and artificial—has been a natural outgrowth of the recognition of the power and use of the algorithm and a key driver of the decreasing marginal value of algorithmic tasks and skills. (p. 40)

Heuristics, in contrast, are guidelines or "informal judgmental rules" (Lenat, 1983, p. 243). More complex tasks, particularly those described as 'ill-structured' or 'wicked,' cannot be addressed through a codified sequence of steps or sub-routines. Larger, more value-based guidelines or heuristics must be employed to analyze, understand, and resolve these problems. Heuristics are generalizable in their flexibility and recognition of the complexity of problems. Moreover, heuristics are often embedded in the values and experiences of designers as a tacit form of knowing (Cross, 1982; Lawson, 2004).

The ADDIE Paradigm

Within the field of instructional design, the term ADDIE is used to describe generally the design process and to structure formally the work of designers into a sequence of steps leading to a completed design. ADDIE, as noted above, consists of five phases (i.e., analysis, design, development, implementation, and evaluation) and appears to be a formalization of vernacular design practices in the field of instructional design, with a wide variety of minor variations to the process in existence (Molenda, 2003). It is comparable to a wide range of design processes in other fields; for example, Osborn's Creative Problem Solving model of 1953.

Over recent years, a wide variation in design processes has been documented in the field of instructional design. Many in-depth explorations of these design methods are readily available (cf., Becker, 2007; Jonassen, 2006; Visscher-Voerman & Gustafson, 2004). "At least a dozen authors have variations of this basic theme with 4–10 stages that portray design linearly as a progression from the less determined exploratory work to the more constrained final production of designs" (Hoadley & Cox, in press). It is not our intent here to re-evaluate the historic and current fluctuations of models and processes in our field. Rather, we begin by sharing a selection of frameworks that we believe provide fresh perspectives for designers fatigued from sifting through antiquated and weathered design processes that do little more than present the phases of ADDIE with creative new titles. Furthermore, it is important to note that it is not our attempt to build these models up for failure, casting them as strawmen in an attempt to illustrate prospective benefits of a contemporary design approach and supplant the existing landscape. Therefore, we will not disassemble and evaluate each process or model individually, but rather expand upon what we believe to be a general shortcoming in relation to fostering creativity and innovation in instructional design. Ultimately, we conclude, with Becker, that most instructional design models "…are far from new, the processes have been given a 'new coat of paint' and formal names, and so are treated as new ideas" (2007, p. 88).

Jonassen's Iterative Model

Jonassen (2006) describes instructional design as "most often a cyclical process of decision-making based upon constraint satisfaction that is modified by personal or corporate beliefs and biases" (p. 26). In Jonassen's Iterative Design Model, after conceptualizing the initial constraints and functional specifications of the project, the designer embarks on repeated sets of decisions closing in on the design solution. During each phase of the process, the role of the designer is to satisfy emerging and dynamic constraints in order to advance holistic understanding of the problem and context. Hoadley and Cox (in press) characterize "good" design as iterative by definition, using a constant cycle of improvement and feedback. Likewise, Jonassen's process can be described as a convergent spiral toward a successful design solution.

To ensure successful design work, Jonassen argues that designers must "address the constraints imposed by the context" (p. 26) through employing an iterative, cyclical series of decision-making processes with the goal of design to *satisfice*,* rather than optimize. This model, while it is rooted in the basic ADDIE structure, begins to dissolve some of the rigid, sequential steps of previous forms.

Kirschner's Six-Stage Model of Interaction Design

Kirschner's model of interaction design continues this interactive and reflective process through a series of phase-based questions. Interaction Design is a

*Simon (1993) describes *satisficing* as "the process of finding alternatives by heuristic search with the use of a stop rule based on adjustable aspirations" (p. 46).

discipline focused on creating useful and engaging experiences that appeal to and benefit the user (Kirschner, Strijbos, Kreijns, & Beers, 2004) and is a framework specifically anchored in utility, usability, and aesthetics. Whereas utility is defined as the array of functions and features incorporated by a system (i.e., the tools present in the software that satisfy the outlined requirements), usability is concerned with the effectiveness, efficiency, and satisfaction with which learners can accomplish a set of tasks. Distinct from instructional design, the field of interaction design is also concerned with aesthetics and, more precisely, how the design appeals to and benefits users.

To foster acceptance of the utility, usability, and aesthetics equilibrium desired in interaction design, Kirschner *et al.* (2004) introduced the six-stage model of interaction design. Using this method, designers challenge themselves with a series of questions throughout the process to further understanding of the problem. Initially, designers must explore the realistic actions and needs of learners in order to identify areas of potential support and pinpoint constraints (i.e., physical, logical, and cultural) that will ultimately shape the final design. Once the design has been implemented, designers explore how the solution is perceived and used by learners in an authentic context. The process concludes with an investigation and description of what learning has actually been achieved through use of the design.

The process relies heavily on an integrated system of questions that apply values to a standardized design sequence. Similarly, Silber (2007) examined the instructional design process and advocated for a principle-based design process. Although we believe these efforts represent a fresh course for the field, we contend that the inherent values of the system should be more overt, and specifically integrated into the roles of the design participants, instead of simply part of their adopted activities; they must *become* designers.

Ten Faces of Innovation

In what we believe was a sizeable stride forward in this direction for creative processes, Kelley & Littman (2005) presented ten roles that designers and design teams can use to foster creativity and innovation. Their roles include the anthropologist, the experimenter, the cross-pollinator, the hurdler, the collaborator, the director, the experience architect, the set designer, the caregiver, and the storyteller. From contributing insights by observing human behavior (i.e., the *anthropologist*), to bringing people together to get the job done (i.e., the *collaborator*), to generating persuasive stories relative to context (i.e., the *storyteller*), Kelley & Littman's ten players illustrate a unique set of values, beliefs, characteristics, skills, and attributes that a design team should embrace when attempting to design innovative solutions for the contemporary marketplace. Most importantly, their design framework focuses on the type of designers needed to harness a successful and innovative project, rather than a series of phases, processes, and models that describe how such a project might evolve; in essence, successful innovation stems from *people, not processes*.

Role-Based Design

We believe the process of instructional design is in need of foundational transformation, from one of following a codified algorithm to a new way of designing that uses specific roles to define project values, responsibilities, and activities. In our description of Role-Based Design, we present a series of archetypes, that is, a selection of real professions which are applicable perspectives for professional behavior in instructional design. We describe an instructional design process that includes the ***artist***, the ***architect***, the ***engineer***, and the ***craftsperson***. These are professions and descriptors that are well known to all in society.

As archetypes, these selected roles are exemplars of behavior and practice, personifications of value sets and philosophies, and are infused throughout a design project. "These values may not yield a specific chronological progression of stages, but instead may manifest in a stance that is taken in all the activities in design" (Hoadley & Cox, in press). While every metaphor is not an exact match, we seek to apply to instructional design the best qualities from each profession. For example, complementary to the artist's divergent world view is the convergent and research based understanding of the engineer.

Each of the four roles (see ***Figure 1***) will be presented here in the general order of a design process; each role, in turn, leading the project and applying their own values and expertise. For example, the artist explores creative ideas for a project; the architect examines the challenges and context of the problem from a systemic and strategic viewpoint; the engineer applies scientifically based logic to the development and integration of the solution; and the craftsperson invests fine attention to detail and aesthetic discipline to the execution and production of the design.

Each role, from the creativity of the artist, to the care and completion of the craftsperson, is critical at some point in the process; each serves as check and balance for the other roles. At the same time, each exemplar participates throughout the design process. Role-Based Design is both sequential and concurrent—the craftsman bringing the artist back to earth while understanding the creative nature of the work; the architect reminding the engineer of the broader and aesthetic needs of the project. Each role is constant and integrated into the entire process, not taking the lead all the time, but present and engaged throughout.

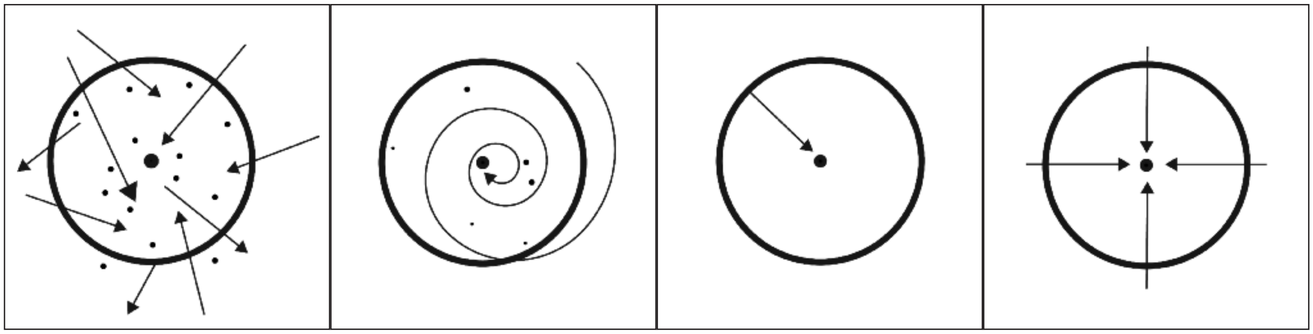

Figure 1. Role-Based Design: The four roles of Artist, Architect, Engineer, and Craftsperson are represented visually through a series of problem spaces (the outer circles) and potential solutions (the inner dots). The various arrow-tipped lines depict how each role explores the problem space to design and implements a solution (or solutions); these will be discussed in greater detail throughout the following sections and in subsequent articles in this series.

The Instructional Artist (Playful Experimentation)

In many design projects, under time or budget constraints, a single driving concept is selected very early in the process and essentially "passed down through the ranks." These preconceived, but well-tested, ideas are often built from experience and used without the rigor of a challenging design process.

We believe successful design processes require a dedicated period of experimentation, of development of divergent and unusual ideas, and the ability to embrace failure as a means to innovation. In short, the instructional designer must also work as an artist. A corporate credo of IDEO, a highly successful design firm, is "Fail early, fail often" (Kelley & Littman, 2005, p. 52). IDEO's corporate culture has embraced the role of the iconoclast artist in their work; creativity by definition differs from the norm.

Artists often begin their practice with a skill in their chosen medium, from drawing to painting to digital interactivity; similarly, many in the field of instructional design begin with a skillset in electronic media development. Artists are advocates for user/viewer experiences and aesthetics, both areas with vast potential for improvement in the field instructional design. Artists often have a high level of creativity, and in many cases work outside of mainstream society. Furthermore, artists embrace unexpected results, uniqueness, and, at times, the disturbance of the status quo. The goal is to advance the understanding and development of new ideas and not necessarily to complete a finished product. In most cases the artist works without a client or direct patron, independently advancing the work.

In Role-Based Design, the *instructional artist* (see ***Figure 2***) is responsible for stimulating divergent thinking both at the beginning and throughout the project, for advocating aesthetic qualities on a continuous basis, and as the "what if" person on the design team. As an educational explorer, the artist uses instructional challenges as stimuli to explore media and their potential affordances. Self-criticism plays a significant role in the thought pattern of the instructional artist, hoping to better understand one's self and the design challenge. Within instructional design, this phase would allow for an exploration of ideas that could prove unsuccessful, but could also

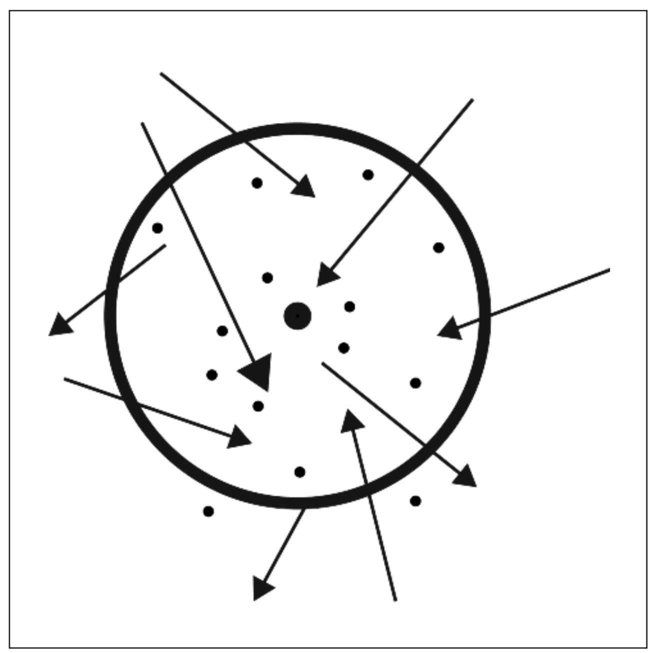

Figure 2. The artist explores all facets of the problem space by starting within and outside early problem specifications and context. Ultimately, many solutions, some potentially successful and some potentially detrimental, are explored and generated through an open-ended, dynamic process of playful experimentation.

lead to innovative leaps. Accepting greater risk in the design process, the wager is to gain substantial increases in the value of design work.

Design projects often do not have extensive teams for the design of a project, and may be completed by a single individual. In this case, each of the roles of design is adopted in turn, repeatedly, throughout the project. Even at the conclusion of a project, the role of the artist must remain in evidence.

The Instructional Architect (Holistic Conceptualization)

Central to any design process is an understanding of the whole project, in other words, a view of the project in conceptual, theoretical, and contextual terms. Design processes must identify and recognize the assumptions of both the design problems and the designer, and to be truly effective, must question the nature of the design challenge in itself. The question that must be asked by the designer or design team is "What is the nature of *this* design problem?"

A balanced approach is needed in any design project, including those in instructional design; we call this broad role the *instructional architect* (see ***Figure 3***). The instructional architect values aesthetics and user experiences, research-proven results, and technical capability. We view the architect role as one that journeys beyond merely solving the problem to extending the boundaries of project resources past the technical and educational specifications of the project. The instructional architect seeks projects that transform the whole educational experience, having a long view of design and one which is not merely project centered.

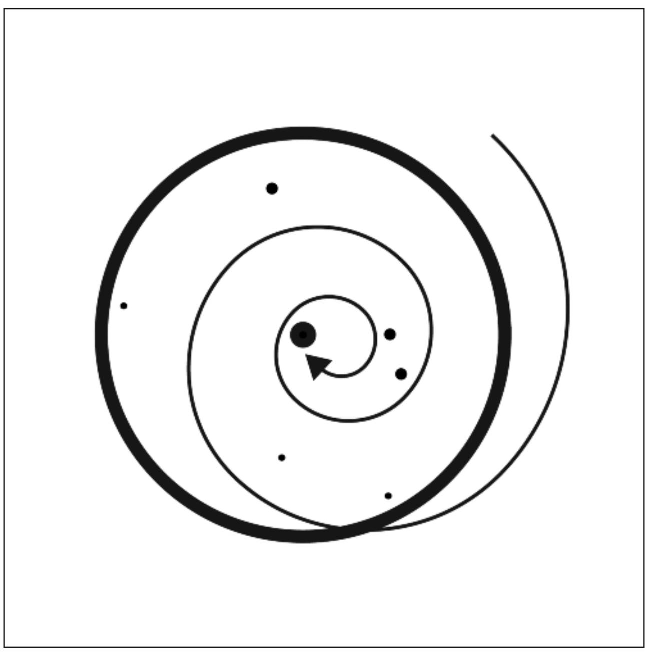

Figure 3. The architect explores the problem space through a holistic process of continuous context examination and discovery. Essentially responsible for creating 'place' out of 'space,' the architect represents a thorough conceptualization of both problem and user contexts.

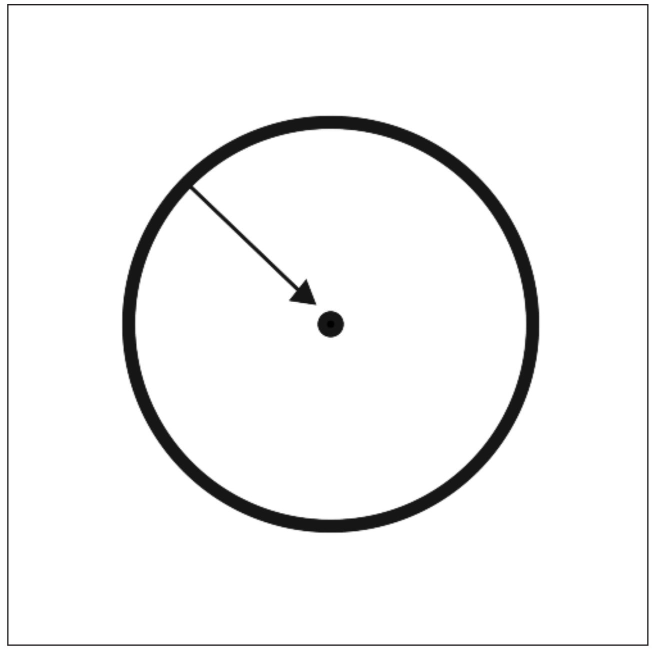

Figure 4. The engineer explores the problem space through a research-driven path that begins with initial problem specifications, ultimately zeroing in on the development of a single solution through application of scientific and theory-based methods.

The Instructional Engineer (Scientific Realization)

Much of the current practice of instructional design deals with the application of research-based principles and theories; these are used to organize, assemble, create, order, and work for the benefit of our society. Within this writing, we use the term *instructional engineer* (see ***Figure 4***) to exemplify the most common perception of the main role in instructional design; the application of educational theory to develop materials, curriculum, and structures for learning through computers and related media.

> The scientific method is employed to discover the nature of what exists, while design methods are employed to invent things which do not exist. Science is essentially analytic, and design is constructive (Rowland, 2005, p. 81).

There are those in the field of instructional design that believe, explicitly or implicitly, that the field should be differently named: “Some object to the word ‘design,’ suggesting as it does a rather arty orientation, and insist that what we really need is ‘instructional engineering’” (Shepard, 2003). The argument is that this would lead to a more rational and systematized method of producing instructional materials; a strict, algorithmic process with guaranteed results. In contrast, however, as the design process is non-algorithmic and without guarantees, richer and more innovative results are produced out of apparent disorder.

Both within the field of instructional design and in the broader description of design, we value the work of engineers, as highly trained professionals with logical and empirical standards. Specifically, the engineering responsibilities within instructional design include product usability, audience understanding, and reaching educational goals. The theories and ideas of research drive the development of instructional materials through the role of the engineer, balanced with efficiency and technical soundness. We expect engineers, within instructional design or in alternate domains, to be logical, rational, inventive, and efficient. These are universal goals and are the essences of the engineer role.

Within the current practice of instructional design, most work initiated by the instructional engineer is completed by technicians with little input as to design ideas or values or change. The conceptualization, the planning, and the strategic view have all been completed, and the task of implementation and development must occur. During project production, however, there is a choice, between rote work and engagement, between craft and mere completion. Unfortunately, we believe that most design work does not evolve during the implementation phase, as it is manufactured by others separated from ideas or aesthetics.

The Instructional Craftsperson (Experienced Evolution)

Instructional design materials are often produced by a *manufacturer* and not by an engineer. The manufacturer frequently is a technically skilled individual applying a pre-defined design template to solve an educational problem, delivering results as efficiently as possible. The solution to an educational problem is given or dictated to the manufacturer, whose responsibility is one of formatted production. Production consistency and stability are of primary value, resulting in products that are predicable and functional. As one expects a recipe from a cookbook to be predictably good but also what was intended, one should expect the results from a manufacturer to produce consistent, but not innovative, work.

We seek to replace the role and inherent perspective of the instructional manufacturer with that of an *instructional craftsperson* (see ***Figure 5***). The values of the craftsperson are critical to the quality of the end artifact as part of the full design process. For the health of the design process and the participant designers, we argue that this portion of the work be positive, additive, generative, and ultimately forward thinking to ensure an ongoing improvement of quality in future designs.

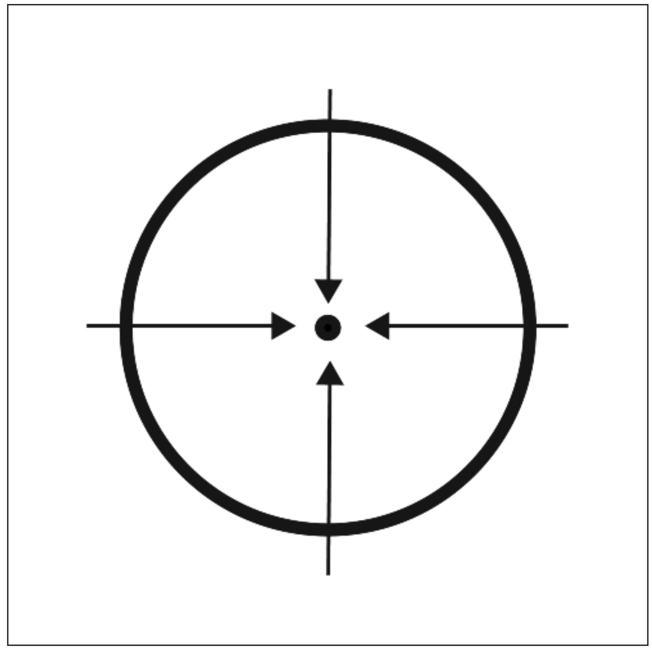

Figure 5. The craftsperson explores the problem space with experience, efficiency, and care for the quality of the final solution. Beginning outside the problem specifications to ensure no stone has been left unturned, the craftsperson develops and implements the solution with fine attention to detail from all angles of the problem.

We envision the instructional craftsperson as a designer with a high level of implicit knowledge gained through experience, and one who seeks quality both in aesthetic and technical terms. The instructional craftsperson may value the final product more than the client or user; analogously, furniture craftspersons may have a similar affection for their designs as well, earned through patience and calluses.

This is not a semantic change for the instructional design process, changing the terminology from “manufacturer” to “craftsperson,” although the characterization would be easy to adopt. A mere change of title would not change the process nor the end product; there would be no design improvement. As with the late project use of a graphic artist to apply surface aesthetics to an interface, there is little to no value in the change. For the instructional craftsperson role to be valid, for there to be a role of craft in the instructional design process, craft must be immersed within the entire design process. The craftsperson should have specific responsibility for completion, to be sure, but as with each of the other roles, remaining part of a fully integrated design methodology.

Many in the field may share the values of the craftsperson, but are still constrained by practice, economics, or choice. Our goal is to encourage thoughtful and engaged completion of instructional design projects; we want instructional design projects to be crafted, designed, and completed with engagement and care, which may be possible with a more formal designation of this role.

> As a verb, 'to craft' seemingly means to participate skillfully in some small-scale process. This implies several things. First, it affirms that the results of involved work will still surpass the results of detached work. To craft is to care. Second, it suggests that partnerships with technology are better than autonomous technology. For example, personal mastery of open-ended software can take computers places that deterministic software code cannot. Third, to craft implies working at a personal scale—acting locally in reaction to anonymous, globalized, industrial production—hence its appeal in describing phenomena such as microbreweries. Finally, the usage of 'craft' as a verb evades the persistent stigma that has attached itself to the noun. (McCullough, 1998, p. 21)

We share today, a modern view of the "craftsperson," a positive conception of a skilled worker creating quality work, an artisan. The concept was developed out of specialized guilds, and relied on quality standards and a mission of training the next generation. Picture a current-day craftsperson, an artisan baker, for example, and we understand the quality of their work. Although bread can be made through highly mechanized methods, the quality and the experience of the artisan loaf may be unmatched. The baker is personally engaged with the work, somewhat isolated from "the product as commodity," working at their own pace but still efficient, and the schedule is not of prime importance. Each bread rises at its own rate.

Practical Implications for Design

As a means to structure the work of instructional design, Role-Based Design is meant to be flexible and easily applicable to most design situations. Role-Based Design can be used in a large team where members of the design team are assigned specific roles in the process.

Roles can be assigned to individuals or to sub-teams, for example, with one as the designated "artist" on a project, advocating for creative and novel solutions, or with one team being principally responsible for ongoing qualitative improvements at the completion of the project.

One challenge for implementing RBD in a traditional design team is that habitual procedures and processes would continue; time pressures still exist, research findings can dominate design ideas, and failure (the valuable byproduct of experimentation) is discouraged.

Alternatively, Role-Based Design can be effectively integrated within small groups or as part of the process of a single designer. In these cases, the roles would be assumed at various times in the design process, beginning with the artist and continuing to the craftsman. However, to be effective, the roles should reoccur and be integrated throughout the process; for example, the mental voice of the artist should always

Overview of Upcoming Articles

This article is the first installment in a series of four articles which will be featured in upcoming issues of *Educational Technology*. They will be dedicated to the illustration and exploration of Role-Based Design as a framework for the field of instructional design.

In the second installment, we will shine a light on the roots of the design process, the intrinsic illustration of the wicked or ill-structured problem as examined by the instructional artist and instructional architect. We will explore the innate values, philosophies, characteristics (historical and present), responsibilities, research, and contemporary practice of these two roles and introduce an authentic instructional problem addressed from the perspective of each. Parallel to our depiction of the artist and architect, we will examine the importance of creativity and innovation in the design process and discuss a collection of questions and practices that designers can employ to encourage and foster these essential attributes.

The third article will focus on a similar interpretation of the instructional engineer and instructional craftsperson, and how they complete the Role-Based Design framework. The scientific and research-based logic of the engineer is a role that is well supported in the development of instructional designers today. However, as much work in the field today is manufactured as opposed to crafted, we anticipate that major changes will occur through reorientation.

In the final installment, we will provide an authentic narrative of three real-world design problems addressed through practical integration of the four roles and perspectives of Role-Based Design. Specifically, we will examine the design of an e-assessment environment that transformed language learning and performance evaluation in post-secondary American Sign Language. Also included will be an examination of the design process of a collaborative, multi-scaffolded hybrid learning environment for geospatial technology integration in K–12 classrooms, and the design of a culturally-iconic urban center for theater performance, production, education, and professional training.

be present in the design process, advocating for more creativity and exploration.

Creativity is an important goal of Role-Based Design, and titling a role "artist" implies sole discretion for creativity and innovation. On the other hand, many engineers successfully go beyond the reductionist process of engineering in reaching a single solution. Each of the roles, architect and craftsman as well, has the responsibility to ensure creativity in the design project.

If creativity is solely the responsibility of one role, such as the artist, then the project will not benefit from the unique experience and vision of the other members of the team. To some extent, all designers, from artist to engineer, architect to craftsman, are creative. These roles are all involved in solving problems.

Through Role-Based Design, we seek to build in a role for creativity and aesthetics throughout the project, not simply as a tertiary addition to the end of a project. We seek to ensure that each phase of a project does not settle for "done," but rather continuously seeks to improve and innovate. □

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Invitation for Input

We would like this exploration of Role-Based Design to exist as an active, participatory investigation of the design processes that foster creativity and innovation in our field. Therefore, we invite you to submit your thoughts and critiques of our role-based perspectives, as well as share your unique design stories and narratives, successful and otherwise, either by e-mail to the authors or by visiting our Role-Based Design community through *http://www.ltspaces.com/rbd* .

Our Contributing Editors

The Contributing Editors to this magazine (see the listing on page 2) are among the world's most distinguished experts on varied aspects of the field of educational technology. All Contributing Editors write regularly for this magazine, and on occasion guest-edit special sections or entire special issues dealing with issues related to their particular areas of expertise. Reader suggestions are welcomed regarding persons to be nominated to serve on the board of regular contributors.

Games and (Preparation for Future) Learning

Jessica Hammer
John Black

What makes games effective for learning? The authors argue that games provide vicarious experiences for players, which then amplify the effects of future, formal learning. However, not every game succeeds in doing so! Understanding why some games succeed and others fail at this task means investigating both a given game's design and the educational context in which it is deployed. Based on their ongoing research, the authors propose concrete and specific ways to enhance the learning potential of play under the "preparation for future learning" model.

Our generation is not the first to consider games and play as tools for learning. Play has often been framed as a crucial element in child development (Sutton-Smith, 1997), and therefore has been welcomed into the classroom, particularly for young children. While games have had a somewhat less friendly reception, this is rapidly changing. Driven by a multi-billion-dollar digital game market, games are receiving more serious critical attention from both academics and educators—and, correspondingly, more serious thought about how they can be deployed for learning.

Clark (2007) and others have called for a deeper investigation of the educational value of "serious" games, which claim to provide learning value. If we intend to use these games to teach, we owe it to our students to understand their educational merits. However, such an investigation must go beyond the simple question of whether students can learn from games. We must consider the models by which we expect such learning to occur, which games we consider "serious," what makes particular games effective, and how we can take advantage of the "gameness" of games (McLuhan, 1964). By this last, we mean not only the passionate engagement with which people play, but also each game's ability to model systems and the vicarious experience that players gain during play.

This article outlines one possible approach to learning from games, which builds on the ***preparation for future learning*** model developed by Bransford and Schwartz (2001). We argue that games can support classroom learning, given proper attention to the deep structure of games and how players genuinely engage with that structure. Given the results of our initial research study exploring this theoretical model, we make recommendations for how this theory can shape our educational practices around games.

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Evidence for Learning from Games

The evidence for learning from games is distinctly mixed. A recent review of the literature found highly equivocal evidence for games and classroom learning (Chen & O'Neil, 2005). However, when learning is considered more broadly, there is strong evidence that game-play can help players learn.

Spatial and attention skills, for example, correlate positively with game-play (De Lisi & Wolford, 2002; Green & Bavelier, 2003; Greenfield, deWinstanley, Kilpatrick, & Kaye, 1994), while game-playing surgeons completed laparoscopic surgeries 27% faster than their non-game-playing peers, and with 37% fewer errors (Rosser, Lynch, Haskamp, Yalif, Gentile, & Giammaria, 2004). Game-players, like bilingual people, surpass mono-lingual people at mental flexibility and switching between cognitive tasks. These skills correlate with life-long mental acuity and ability (Bialystok, 2006).

Games designed to teach specific skills have yielded some positive and some mixed results. Games have been quite successful at teaching children how to cope with chronic diseases, for one (Lieberman, 2001). Barab's work with *Quest Atlantis* has had promising results, increasing students' learning of science and social studies in both classroom and after-school settings (Barab, Dodge, Jackson, & Arici, 2003). Squire's work on *Civilization* also seems promising for fostering engagement and learning (Squire, 2004). However, other research on games teaching history in the classroom has yielded mixed results (Egenfeldt-Nielsen, 2005). While the game-playing group of students showed more engagement with the topic, they performed worse on the final learning measures than did a control class.

The bulk of these studies are tied to particular models of *how* games support learning—whether through situated cognition, participation in communities of practice, anchored learning, or role engagement. But there are also questions of *in what context* games support learning. Are games a replacement for classroom learning, as Prensky (2005) suggests? In that case, the standard of proof must compare learning from games to learning in traditional classroom formats.

By some estimates, nearly 10% of American classrooms are already using games to teach (Edwards, 2006), including *Civilization* (Epstein, 2005). The classroom, however, is not where most play takes place. People may choose to play games on their own time as a leisure activity, and do—some for upwards of forty hours a week! Few individuals similarly commit their time to, for example, reading history textbooks. Our model, therefore, chooses to look at the academic benefits of naturalistic, "in-the-wild" game-play. We must reorganize our theories, and our notions of what makes good research, to match.

The PFL Approach

We recognize that there are serious structural challenges to bringing games into the classroom. Some are practical: For example, games are expensive to build and take a long time for students to master. Others have to do with the differing agendas of games and classrooms, and the structural and institutional differences between them (Hammer & Crosbie, 2005). However, there is no reason why learning activities cannot leverage what games already do remarkably well: Encourage people to play them in their leisure time.

Rather than argue that games belong in the classroom—an argument we leave to others—we choose to investigate the value of leisure play. Can leisure play support classroom learning? And, if so, how does it do so? Games clearly do something *different* from, say, a lecture or a problem set. How can we leverage the unique advantages of play to help people learn in more formal settings?

In addressing the question of whether games support future learning, we have chosen to use the theory of "Preparation for Future Learning," or, for short, PFL. This theory is articulated by Bransford and Schwartz (2001), who argue for a reconceptualization of transfer. Rather than focusing on the ability to transfer specific information to a new context, they suggest that active experiences with a domain—even in an informal context—prepare students effectively for future formal learning. This draws on the work of Dewey (1938), who argued that learners constructed knowledge based on their former experiences in the real world. By providing an enriched set of experiences, learning as well could be enhanced.

We believe that leisure game-play can provide meaningful prior experiences that directly support players' later academic learning. This argument is based, not on a game's "face validity" for academic concepts, but rather on the underlying processes that games incorporate. Building on theories of game-play as process-oriented (Lindley, 2002; Salen & Zimmerman, 2005), we propose that players focus not only on the *apparent* content of a game, but also on the processes and systems that underlie it. Players develop a body of knowledge about how *systems* work that they absorb from games, but cannot necessarily articulate.

Measures of future learning, therefore, should include not only the obvious tests of whether students have adopted the language and content that appears in a game. It must also measure the complexity and sophistication of their ideas about how the learning domain works. If games support future learning at all, they are likely to support learning that is deep and sophisticated, providing players with new ways of thinking and constructing knowledge.

From a PFL point of view, game-play enriches future formal learning experiences. Time spent playing the game is both valuable and pleasurable—but the positive learning effects come about when the game's virtual experience is later evoked in a formal context. The game allows students to get more out of their classroom time. It heightens the impact of formal learning, precisely because students are better prepared for it.

Our research model builds on this understanding of future learning (Hammer, Black, Andrews, Zhou, & Kinzer, 2007). We examined two games which connect closely to particular knowledge domains—*Civilization*, which explores the domain of history, and *SimCity*, which relates to the domain of urban planning. By comparing the learning rates of *SimCity* experts and *Civilization* experts in each domain, we were able to directly examine whether game-play prepared students for future learning. We found that playing *Civilization* did indeed prepare students to learn history—though, equally interesting, we found that playing *SimCity* did not prepare students to learn about the domain of urban planning. Both of these learning effects built on leisure play to support learning from an academic text.

Implications for Education

There's an easy tendency to dismiss leisure play as meaningless. For this reason, we believe it is crucial to emphasize the central point of this study. Games do not have to be inserted into a classroom setting to support learning. Leisure play can be a productive and fruitful activity in its own right—given the proper follow-up in terms of formal learning. In fact, leisure play can amplify and deepen the formal learning experience.

Players' experiences in games give them intuitions, models, and ideas about how the world works. Often, these are experiences they cannot have in other circumstances. Where else can an ordinary person lead a country to greatness, or lay out the plan of a city for themselves? Games can be—and are!—designed to encourage players to engage with the complex structures and models underlying play. Players' engagement, on their own time, with these kinds of experiences, can only represent an educational advantage.

Equally important, though, is the role of formal learning. Formal learning helps students organize and access the knowledge they derive from their experiences. On our experiment's test of prior knowledge, we found no difference between *Civilization* and *SimCity* players in their knowledge of either history or urban planning. The benefit in history to expert *Civilization* players only came about *after* the formal learning occurred. In other words, a game can provide organizing experiences and support for a given learning domain—but it, alone, is not enough to understand the domain at hand. There must be some kind of formal structure (though, of course, this does not necessarily have to occur in the classroom) to help students make sense of their learning experiences in the game.

Of course, this is an argument that can be made for many forms of media, including books, films, and even lectures. Games are hardly the only medium where formal structure helps students make sense of their experience. However, given our research results, we believe that formal support may be particularly important for games.

First, games for learning are a relatively immature medium. Books, for example, have had hundreds of years of deliberate design for accessibility and usability. Innovations ranging from the table of contents to the index have made books sophisticated textual delivery systems (Manguel, 1997). In schools, students receive years of education on how to use these innovations and learn independently from books. Books are a highly mature learning technology! Comparable work on games is only now beginning, and students certainly do not receive equivalent training in learning from games as a medium. Formal support, then, must fill in these gaps.

Second, players of games have far more idiosyncratic experiences than readers of books, viewers of films, or listeners to lectures. Even if two readers understand a book differently, the words on the page ultimately remain the same. However, two players of a well-designed game—one in which players are confronted with meaningful choices—are not guaranteed to have a common base of experience. Tying these diverse experiences together requires developing meaningful common abstractions, a challenging task.

Finally, games function by creating a "magic circle," a self-contained world in which the rules of the game are paramount (Huizinga, 1971). The magic circle is an essential part of the "game-ness" of games. Players may need extra help understanding how to apply their knowledge outside the deliberately set-apart context of play.

The role of formal support for games, however, is hardly the only question at hand. When it comes to games, there is always the question of "How much?" and "How long?" We often expect children to learn from games (or other media) after brief periods of exposure. However, we found that the preparation for future learning effects only came into focus for expert players—ones who played more than 25 hours a week at the peak of their play.

What this suggests is that games may not be a good way to deliver superficial knowledge, knowledge that could be acquired easily in some other way. Players must develop expertise with the game's system before the preparatory effects become clear, and this takes both time and concentrated attention. Because players must be game experts in order to benefit their future learning, we should concentrate on developing learning activities that build on expert activities and knowledge.

In addition, we should consider how to use game expertise as effectively as possible. Rather than build just one lesson around students' expert knowledge of games, we must consider how to use the shared common experience of play in a variety of classroom applications. For example, *Civilization* is most obviously used to teach history, as our study demonstrates. However, the game can also be used to teach programming, math, and logic. It could even be used to teach literacy skills, particularly if extra-game activities such as walkthrough use are included. With this approach, the time investment required for students to become expert has a much larger payoff.

Alternately, we can investigate ways to move game-play outside of the classroom. Although game-play benefited *Civilization* players in learning history, we believe the benefit does not justify twenty-five hours of classroom play a week. However, just as a teacher might assign reading to be done at home and discussed in class, students may play games outside the classroom and then return to the classroom with a fund of additional knowledge. Teachers could assign "summer playing" assignments, just for example, and then build on those in-game experiences during the school year. Students might also play in after-school programs, where teachers or staff are available to supervise and support play (Squire, 2005). Both these forms of leisure play do not directly compete with classroom time or with formal learning experiences.

Active support by teachers provides another option for addressing the time issue, by helping players achieve expertise in shorter periods of time. Teachers might intervene during play, or create directed exercises designed to build specific skills. However, scaffolding can also take place on its own, outside the classroom: players often achieve a significant level of expertise with the help of peers, for example. Teachers can bring this informal scaffolding into the classroom by encouraging students to take advantage of pre-existing game communities, or by asking expert students to teach their less-expert peers.

Given the time investment required to benefit from play and the many pressures on classroom time, these solutions can make learning from games more feasible. Our findings about the time commitment required for PFL effects to appear do not mean games cannot be used in the classroom. We believe, however, that educators do need to consider how to get the most educational return on their time investment. That might mean building multiple lessons around the game, shortening the time to expertise through scaffolding, or offloading the time required to build expertise onto students' leisure play.

Finally, there is a tendency to frame the debate about 'games' as if they were some kind of unitary category. In reality, though, games are wildly diverse objects, and such generalization undermines any possibility of understanding the way that games function in practice. When we consider games as diverse as *Guitar Hero, Pokemon, Making History*, and *Settlers of Catan,* it makes less and less sense to assume that all games will be equally good for learning, or that they will be good in the same way.

Even among games that are apparently similar, it's clear that specific design decisions may support or undermine future learning opportunities. We chose games that appeared quite similar to us. Both *Civilization* and *SimCity* are relatively open-ended simulation games which involve making strategic choices about the allocation of resources within a geographic area. Nonetheless, we found the games produced quite different results! *Civilization* helped experts learn history, while *SimCity* did not support experts' future learning of urban planning.

We argue that specific differences in game design made players more or less likely to learn from their experiences in the game. If small differences in design, even between games that appear quite similar, can impact the game's educational success, it becomes even more important to consider individual games on their own merits rather than to talk about 'games' generically.

Implications for Design

If a game's design can have such a strong effect on its learning potential, it becomes doubly important for us to consider our study's implications for design, as well as for educational practice.

We believe that the core design difference between *Civilization* and *SimCity* has to do with how the game handles winning and losing. *Civilization* has multiple pathways for players to win the game; however, the game provides clear and focused goals, and players can evaluate their actions in terms of short- and long-term consequences. *SimCity*, on the other hand, is often cited as an example of 'sandbox' play. While players can run out of money or have their virtual city destroyed, most goals within the game are player-initiated rather than explicitly supported or enforced by the game system.

Clear goals, as opposed to sandbox play, may allow players to engage in directed practice within the game system. When players must evaluate their actions in the context of larger success and failure, they are encouraged to use their knowledge of the game's system to make good decisions as opposed to just "messing around." They begin to see their knowledge of the game's system as being designed for use—a use which has direct feedback and immediate consequences for play. Lobato (2006) discusses how usable (or "generative") knowledge best supports transfer. We would agree with this, and argue that *Civilization's* clear goals encourage players to make active use of their expertise more often.

Another significant difference between the games is in how they use specific, as opposed to generic, knowledge. *Civilization* contains specific references to historical events, characters, and objects. Players can lead the Aztecs, negotiate with Queen Isabella, or build the Great Wall of China. *SimCity,* however, largely contains generic knowledge. While players can build fire stations or raise taxes, it does not provide the fruitful specificity that *Civilization* does.

We had initially dismissed this consideration, because we expected the games to support systemic rather than factual learning. However, we discovered that *Civilization* players were better able to learn facts, not just systemic knowledge, from the academic text they read. At the same time, informal interviews with *Civilization* and *SimCity* players revealed players talking about how the specifics that *Civilization* provided sparked their imagination. Just what was the Hagia Sophia? Could they win a game where all the American cities were in the right geographical locations?

Given these factors, we have come to believe that the "outward pointers" of *Civilization* may have been a second crucial factor in its successful preparation for future learning. Some players explicitly use these "outward pointers" to think critically about history; for example, one player interviewed described learning about Chinese city-naming schemes in order to name his cities appropriately in the game. Even players who do not use this knowledge explicitly, however, may have been affected by it. We believe these specific references may have primed players to connect their game experiences to their existing knowledge, even though the factual information was not explicitly being taught by the game.

Finally, the choice of what domain to represent is a significant difference between the two games we examined. History is taught in schools, while most people encounter urban planning as part of their day-to-day experience. Players may have continued to draw on their naturalistic understandings of urban planning when exposed to just one formal text, despite whatever grounding the game may have given them. When it comes to history, on the other hand, students rarely have the opportunity to experience it viscerally, personally, and actively. The degree of difference between how students normally encounter history and how *Civilization* is played may be precisely what allows players to benefit from it—because the two approaches may complement each other, as opposed to overlapping.

When designing a game to prepare students for future learning, therefore, it is important to understand the ways in which the domain is ordinarily taught, and what academic experience students are likely to have with the domain. This interaction with the domain is likely to influence whether the game experience supplements, or is redundant with, the prior experiences students are acquiring elsewhere.

Call to Action

Taken together, these ideas suggest that we can use leisure game-play to support students' formal learning—but that it must be a conscious effort on our part to do so.

First, we must find ways to determine which *specific* games provide good preparation for future learning, and what domains they connect to. Some of this may be possible by careful inspection of the games themselves, and certainly research on particular titles can provide concrete answers. However, it is important to begin to generalize learning features that are directly tied to game-play, so that we can begin to understand why certain games are more effective than others at preparing students for future learning.

Second, we must find ways to convey to teachers how they can build on players' experiences in games. It requires significant expertise in game-play to understand the learning content of a particular game, and developing such expertise takes time. We cannot expect our nation's teachers to become experts in each of the thousands of games that are available. Without access to such expertise, teachers can rely only on surface knowledge of a particular game, if they have the time to investigate the games their students play at all.

Teachers who have access to deep expertise about games, on the other hand, can make meaningful connections between play experiences and classroom learning. Even if teachers are not play experts themselves, we can help them learn which lessons and standards a given game embodies. This becomes doubly important when building on leisure play; if not all the students have played a particular game, the teacher must not only find ways to connect the game to the classroom, but also to make the game experience intelligible to those who have not played. As game researchers, therefore, we owe it to teachers to expose the things that experts may experience and know—including the misconceptions the game may promote, and the culture of supporting activities that surround play.

Finally, we must address issues of inequality in game-play. We know that girls and boys tend to play different games, as do children from high-SES and low-SES backgrounds (Andrews, 2007). If only some children have access to the games which successfully support future learning, we may continue to advantage certain cultures of play. Changing the perception among players of what games are socially acceptable is, of course, a complex undertaking. But awareness of which students are advantaged, and which disadvantaged, by their leisure choices about play is a place to begin.

The students who are advantaged and disadvantaged by play, however, may be *different* students from those who succeed in more traditional school activities. Students who do not thrive in traditional classrooms can take the lead as game-play experts, as several studies have found (Squire, 2005; Thalheimer *et al.*, 1992). This difference is an immense opportunity: If we build on struggling students' play expertise in the classroom, the PFL effect can help them succeed in school. The challenge, of course, is to understand which games struggling students play, and how those particular games can support their future learning.

Given actions like these, we can turn students' passion for leisure play into preparation for future learning. Given how much time, energy, and effort kids spend playing games, that can only be a good thing. Rather than try to shoehorn games into limited classroom time, we can build on games *as they are currently played* and still provide good learning outcomes. The question is only whether we are willing to try! □

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Conference Reports

This article begins a new series of occasional reports from leaders and participants at selected conferences held by organizations active in various aspects of the broad field of educational technology. Following are two reports from a recent meeting of the Association for Information Communications Technology Professionals in Higher Education (ACUTA). The Editors welcome reports from attendees at other conferences and events in the educational technology arena (submit inquiries to Lawrence Lipsitz, ***Educational Technology;*** *e-mail:* ***edtecpubs@aol.com****).*

Making Learning Mobile

Corinne Hoch

Anyone familiar with ACUTA, the Association for Information Communications Technology Professionals in Higher Education,* may associate the organization strictly with the campus voice communication and data networking infrastructure. However, ACUTA's reach is truly across the entire range of campus and multi-campus connectivity, in all its forms, including those technologies that are directly tied to the educational process itself.

This was very much in evidence at a recent Seminar staged by ACUTA in Boston, one of three quarterly seminars that the organization hosts on specific technology topics, in addition to its annual conference, a broader event. ACUTA is the only international association dedicated to serving the needs of information communications technology professionals in higher education, and has approximately 2,000 individuals and 780 institutions as members.

Two particular presentations at the Seminar focused in depth on educational technology, but on the whole, the event highlighted how close are the ties between educational and communications/networking technologies. For example, presenters focused on such topics as IP video and its value

*ACUTA, the Association for Information Communications Technology Professionals in Higher Education, was founded in 1972 as the Association of College and University Telecommunications Administrators, hence the ACUTA acronym. The organization and its formal name have evolved with technology, as voice, data, and video technologies have converged over the last 15 years, though the original acronym has remained in place.

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in the educational process as well as the challenges of deploying IP video from a network bandwidth and management standpoint. Or the network considerations in deploying wireless solutions that enable students and others to be connected anywhere on campus, in order to access educational materials in the course of a lecture or outside of class.

Two of the most relevant presentations from an educational technology standpoint were offered by Arthur Brant, Director of Networking Services at Abilene Christian University, and Tom Zeller, Senior Technology Analyst at Indiana University. Mr. Zeller describes his session, focusing on "The Exponential Curve: Technology and Learning in 2019," in the accompanying article. In *this* article, we will look more closely at Mr. Brant's presentation on Mobile Learning Initiatives.

Mobile Device for Every Freshman

Abilene Christian University, a 5,000-student private university in Texas, started the 2008-09 school year by providing its more than 950 incoming freshmen each with an iPhone or iPod Touch. It was part of the university's mobile learning initiative, and while it may seem dramatic, it was simply the next step in a long history of mobile learning research.

This year's freshmen were born in 1990 and have spent the majority of their lives "time-shifting." They have always had the ability to pause, skip, shuffle, and replay both music and video. They have always been connected with others in myriad ways. They have always had cell phones and pagers. For most of their lives, they have been able to "poke" their friends on Facebook, check in using Twitter, and play video games with people from around the globe.

Their classrooms have always been wired, and most have grown up in households with ready access to broadband connections. Today's students have never really known a world without the Internet and its virtually unlimited access to information. As William Rankin, associate professor of English at Abilene Christian, observed, "Instead of having one or two sources for information, students today have thousands of resources at their fingertips. It is becoming our responsibility as educators to help them navigate the mountains of information and learn how to be selective."

Classroom Applications

The convergence of these realities and the introduction of Apple's devices led to the decision to deploy them to the entire freshman class. Even before the iPhone was released, a team of faculty, technologists, and administrators explored the impact it might have on the classroom. The academically-focused endeavor engaged faculty and students to determine whether these devices could be used in the classroom. Shortly after the iPhones and iPod Touches were released, university faculty submitted research proposals if they were interested in exploring how to use these devices in their classrooms. More than half the faculty responded, and from that group, 30 proposals were selected that represented the best cross-section of disciplines and usage cases. The university provided iPhones or iPod Touches to this group, and quickly began receiving overwhelmingly positive feedback.

With a desire to expand the pilot group, in early 2008 it was determined that the most viable pilot group was the entire freshman class. This represented a larger participant pool than anticipated, but offered a great opportunity to assess adoption and efficacy.

When the commitment to broad implementation was made, the Apple App Store and the iPhone software development kit had not been announced. Thus, Abilene Christian focused its development on creating a mobile portal for students. This quickly evolved into a true mobile version of the overall university Website, along with some aspects of the student portal. Great care was taken to craft a "mobile" Website, not just a re-skin of the existing *www.acu.edu*, with a focus on the services and information students needed when on the go.

Useful Tool Suite

A suite of tools for faculty to use in the classroom are designed to help instructors poll the class, solicit feedback, and brainstorm. Further supporting these tools are integrations into the university's Google Apps calendars and Xythos file storage system. All the 150 faculty members using the devices in their classes agreed to use these tools in some aspect of their coursework. But because a strong tool set alone is not enough, Abilene Christian had to make major investments in its existing network infrastructure to support the new devices.

The greatest concern was the breadth and depth of the university's wireless data network. In early 2008, the university was midway through a multi-year plan to deploy a campus-wide wireless network. Residence halls and common areas, such as the library and campus center, had been addressed, along with the College of Business, but other facilities, including the majority of classrooms, lacked wireless access. Campus-wide wireless access, obviously, was paramount to the success of the mobile learning initiative.

There was also concern about the network's capacity to handle such a significant increase in the number of wirelessly connected devices. The initial wireless deployment focused primarily on coverage. As the vision and details for the mobile learning initiative were unveiled, it quickly became apparent that coverage would not be sufficient to meet the goals of the initiative.

The Need for Capacity

Network administrators responded with a revised plan addressing capacity. The response considered the total capacity in classrooms, academic buildings, and residence halls with the assumption that every student would have a wireless connected device. With that in mind, the university embarked on a dense deployment that called for 517 access points in addition to the existing 176 access points already installed.

To meet the mid-August deadline, priorities focused on freshman residence halls and academic spaces, with an ambitious project of installing 322 access points in 122 days. Engineers also focused on wireless congestion; with the installation of the initial wireless network, they observed that 95 percent of wireless devices were connecting to 802.11g radios. Research revealed that laptop manufacturers were typically shipping dual-band wireless equipment, while the iPhones and iPod Touches only had wireless equipment that operated on the 802.11g band.

The decision was made to promote the 802.11a band for those devices that had this capability. This promotion was done automatically with a dense deployment, as the 802.11a radio signals would be stronger than those of the 802.11g radios. Abilene Christian also began configuring university-owned laptops to connect to the high-frequency radios before connecting to the lower-frequency radios. This appeared to accomplish the goal, as the number of devices using the 802.11g radios dropped to 70 percent of the total wireless connected devices.

Registering Mobile Devices

With the wireless network addressed, attention turned to the network registration system. The process of self-registering a network device had inconsistent results, causing a cascading ripple in the confidence of the individuals registering their devices and in the ability of technical support staff to respond. With the assistance of the networking registration system vendor, significant strides were made to streamline the process of self-registration. It was ultimately reduced to three steps, which proved easy to communicate and could be consistently reproduced whether the device was a computer, game console, or iPhone. Finally, to accommodate the smaller form factor of the iPhone Web browser, self-registration pages were optimized for the iPhone.

During the initial weekend that freshmen moved in, more than 650 iPhones and iPod Touches were successfully self-registered, and the volume of support calls was more than manageable.

As Arthur Brant pointed out, "As a university, Abilene Christian University has invested much energy in the consideration of emerging trends in education. We've done this because our ongoing goal to help prepare our students requires a continual re-evaluation of almost everything that happens in and out of the classroom, even a re-evaluation of what constitutes the classroom itself." Clearly, the success so far is a result of the timely convergence of the availability of powerful, portable devices and the arrival of a class of students more than ready for this innovative approach. □

The Exponential Curve: Technology and Learning in 2019

Tom Zeller

In 1965 Gordon Moore remarkably observed that the number of transistors in an integrated circuit had been doubling every 18 months. This, along with his prediction that the trend would continue, is now enshrined as Moore's Law.

Over 40 years later, this exponential curve of technological advance continues. As technologists, we're well aware of the power of this pace of advancement. Computer clocks tick ever faster. CPU chips evolve into multi-headed beasts. Disk storage volumes balloon. Network speeds skyrocket. A corollary of the exponential curve is that the cost per unit (hertz, byte, or byte/second) drops at an incredible rate over time.

An important result of all this improved technology isn't simply that we can do faster what we have been doing. Rather, it creates opportunities to use computers in entirely new ways. Following the time-sharing of the mainframe, the microprocessor gave us our own computer on our desktop, leading to the "killer applications" of the spreadsheet and word processor. As CPU power increased, we got easier to use graphical user interfaces. Only later did beefier machines and the nascent Internet deliver e-mail for everyone. The Web browser would not have been very useful on a 1988 computer, but by the mid-90s it was clearly the way of the future. Even at that time, few talked about music on computers, much less on handhelds. YouTube and the everyday consumption of video didn't arrive until the adequate bandwidth of 2005.

Leveraging Greater Capabilities

All ancient history now. The key question is what new modes of computer use will be enabled by the exponential curve in the next 10 years? If Moore's Law holds, by 2019 our computers will be 30 to 60 times faster. Disk storage will exceed current densities a hundredfold. Network bandwidth will be well over 10 times as fast, even for mobile devices. What will we do with all this new capability? How might it affect higher education?

Reflecting on these questions leads me to consider the fundamental nature of the university experience. How is it different from reading a large stack of books? One difference is the importance of personal interaction with faculty and other students that can occur on campus. Current video links are woefully unsatisfactory in replicating this "in-person" experience.

Will that continue to be the case? I believe that for higher education the most significant advance over the next decade will be the advent of ubiquitous high-definition video.

Videoconferences with small groups using full-sized HD screens approach the quality of in-person meetings, except for passing the doughnut box. In 10 years, large HD screens will be in every household in America and widely available even in developing nations. The combination of increased network bandwidth and improved compression technology will make network delivery of live HD video commonplace.

Impoverished Experience?

A venerable faculty member at IU, addressing the concept of remote viewing of lectures via HD, put the naysayers' viewpoint elegantly and succinctly. He said it would represent an "impoverished experience." This is certainly true; it is difficult to argue that HD is as good as an in-person experience. And, of course, there are situations in which HD video fails completely, for example in delivering a jewelry-making laboratory.

On the other hand, there are two countervailing factors to consider. The first is that incoming freshmen in 2019 will already be completely comfortable with virtual experiences, stemming from years of online gaming, virtual worlds, and videoconferencing with their grandparents. They may not consider virtual experiences to be impoverished at all.

The other consideration is that individuals in underserved markets would accept the technology immediately. In "The

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Innovator's Dilemma," Clayton M. Christensen aptly points out that revolutionary technology does not replace current technology in existing applications, but provides a platform for new uses not enabled by the old technology.

How Large Can a Class Be?

At the ACUTA (Association for Information Communications Technology Professionals in Higher Education) meeting in Boston, I asked the audience to consider the possibility of a university class with 15,000 students. Would it be possible? How could it be approached? The technology investment would be minimal: a high-quality video recording studio with trained professional staff and ample campus and Internet bandwidth. However, two major sociological changes would be required.

One is the strategic vision to create an entirely new business model. University 3.0, one might call it.

The other is the devolving of the many roles played by faculty into distinct functions that would be fulfilled by different people. In the traditional in-person model, faculty members are course designers, content providers, performance artists, mentors, academic counselors, career counselors, and more. Imagine instead an excellent lecturer recording content in the studio. Perhaps this person teams with another faculty member to design the class. There is a full-time position for course coordinator to oversee the logistics.

Some components scale only linearly, namely faculty office hours and graduate assistants. There is a need for perhaps two hours per week of faculty office hours for every 50 to 100 students. This requirement could be met with a dozen or so faculty members working half-time on the class. Likewise, there could be 24/7 graduate student office hours (via full-size HD video), and if discussion groups are called for, they could be via multi-way HD videoconferencing and would be available multiple times each day.

Enabling Time-Shifting

While this approach loses some of value of the in-person experience, it has its advantages. The course would be available worldwide to any Internet-enabled location. Students could time-shift coursework TiVo-style around childcare, eldercare, and work responsibilities. Commute times would be zero for students in the U.S. with HD video displays. While more commuting might be required elsewhere in the world, nonetheless this would make otherwise impossible education at least imaginable.

Furthermore, imagine a student watching a lecture on entropy. She finds the concept difficult, hits the "pause" button, and, with another click, brings up the graduate student's office via HD. She discusses entropy with the graduate student, signs off, rewinds the lecture, and watches again, now with an improved understanding. In some ways, this would actually be superior to the in-person experience.

In conclusion, advances in technology over the next decade will allow remote participation in a virtual university experience which will be close enough to an in-person experience to allow global participation, allowing freedom from the constraints of geography and time-of-day. To realize such global reach requires a fundamental change in the vision, business model, internal organization, and incentives of the university—nothing less than a transformative cultural shift. □

Educational Technology Classics

Assessing Educational Technology

P. Kenneth Komoski

In a world so technologically sophisticated that machines not only produce other machines but in which our most advanced machines may be soon able to reproduce themselves, it may seem somewhat old fashioned to preface these comments about educational technology with the remark that technology is the purposeful use of skills as well as tools.

I feel impelled to make this remark because a few years ago the phrase "educational technology" was little more than space-age educationese for a familiar array of audiovisual devices that had recently been augmented by language laboratories and instructional television; a set of tools perhaps, but hardly tools that were known for being used with either skill or purposefulness. However, in 1958, three unfamiliar devices that carried within them the seeds of a technological approach to the skill of teaching were added to that array, and a radical redefinition of "educational technology" was begun.

These three devices were (1) the simple teaching machines of the types developed by B. F. Skinner and Norman Crowder; (2) the even simpler programmed textbooks developed by Lloyd Homme and Robert Glaser; and (3) the more complex teaching machine that was born when a computer was first programmed as an instructional device by Gustave Rath and others.

The "radical" aspect of these devices was not grounded in any feats of mechanical or electronic engineering, but rather in the process of instructional programming which is the skill that makes it possible for a teaching machine to teach. The development of this process redefined educational technology by injecting into this once tool-tied technology a much-needed set of skills that might lead to the more effective use of all types of educational hardware. It was the emergence of the process of instructional programming that has opened the way to the

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development of a balanced technology within education, and that is helping us to lay to rest the idea that educational technology is simply the array of existing technological devices that can easily be applied to education. In short, instructional programming promises to supply education with skills that will make it possible to turn a rather mixed bag of tools into an effective technology. However, despite the fact that this long overdue balance of tools and skills promises to produce desirable, well-balanced results, it may be important to assess this new technology as best we can in terms of its most obvious strengths and weaknesses in an attempt to throw some light on the results that are likely to occur as it develops within our educational enterprise.

The particular strengths and weaknesses to which I wish to direct your attention stem from three sources: the first source of both great strength and embarrassing weakness is the research base from which instructional programming has emerged. This base is a source of strength because it gives confidence that instructional programming is more than simply a bag of teaching tricks, and because it holds out the promise that with continued research, the skill of instructional programming will one day be transformed from an empirically derived set of teaching rules into a technology based on a reliable set of scientific principles.

Thus, this research base is potentially a great source of future strength even if it does not, as yet, offer solace to the working programmer during the wee hours of the morning. But the present inability of research to supply answers to many of the practical problems that plague instructional programmers is not the weakness I have in mind. This more mundane weakness has to do with the fact that because programmers are involved in a "science-based" technology, their most trivial results are often greeted with respect by laymen and educators alike.

Too Much, too Fast

This is clearly an unfortunate state of affairs, and one that invited the rampant overselling of the first teaching machines and programmed textbooks a few years ago, when door-to-door salesmen were giving gullible parents the impression that the entire psychological community had joined together to produce a "scientific" device that could make Johnny read or do anything else, just as soon as the home office arranged to have it programmed.

As a result of the pressure to "get it programmed," there was a rapid horizontal spread of the first few useful skills generated by education's new "science-based" technology; a spread that was so rapid and so horizontal that it resulted in a discouragingly low level of competence among those who ended up with the responsibility for producing the programs that were to carry the new technology into the classroom.

All the weaknesses that one might expect to find in the use of an under-developed technology by inexperienced practitioners were clearly apparent as early as 1961, when a parade of unimaginative, redundant, instructional programming began to enter the schools. These programs are still very much with us today, and we may see them or programs for which they will serve as ready models as we enter the large-scale utilization of educational technology that is just around the corner.

I simply take this large-scale utilization for granted as the inevitable outcome of commitment on the part of the Federal Government to supply American schools with the financial resources necessary to increase the quality of instruction, and the equally strong commitment on the part of American industry to convince schools that this quality can be achieved by utilizing a technology that puts "scientific" skills to work by means of various "systems of devices," led by the most versatile device of them all, the computer.

The list of companies that will soon be following this approach to the school market reads like a "Who's Who of American Industry": IBM, General Electric, Westinghouse, RCA, CBS, Xerox, ITT, Raytheon, and Litton Industries; these represent only some of the major corporations that are planning to play a central role in the development of what could conceivably become the largest industry in the United States before the end of the century.

These corporations, and the new industry they comprise, represent the second source of strength and weakness with the new educational technology. First and foremost, this emerging industry has within its power the ability to compound either the strengths or the weaknesses that are associated with the newly acquired research base of a redefined, but hardly refined, educational technology. On the plus side, therefore, it seems almost patently obvious that this new industry will, in fact, strengthen the future research base of the new technology. This is true because many of the companies in the industry have, or are building, research capabilities that are comparable to, if not far better than, the university laboratories that established the technology's present research base. Granting that much of the research done at these industrial research facilities will be redundant, and/or strictly proprietary, it will inevitably build a broader base of new research faster than could be built by university activity alone.

Research Needed

There are obviously many aspects of the learning and instructional processes that need to be researched, some of which are more fundamental than others. And considering that the members of the "old educational technology industry" (that is, the producers of audiovisual equipment and films, along with the entire textbook industry) would never have invested in "basic" research even if they could have afforded it, it would seem almost mandatory to say a hortatory word here about the need for more and more research into such basic problems as motivation and learning. But if there is one thing that the major companies in American industry do not have to be told it is that the mother lode lies in important basic discoveries; the kind of discoveries that don't merely create new products but point the way to whole new technologies.

Therefore, it may come as something of a surprise to call for anything that might possibly draw attention away from such important research. But the new industry is in a position to fill an important gap in the technology by addressing a large part of its initial research to the solution of a pressing, practical problem that was largely ignored by the scientists who built the present research base. Those early researchers were primarily interested in the control of learning. Their initial research employed devices and tangible rewards which were used to control the learning of lower organisms.

The first teaching machines were, in fact, comparable devices designed to control human learning, and instructional programming was, at least at first, a literal by-product of those early teaching machines. That is to say, the early and still dominant form of programming was an attempt to control learning by means of words. As a result of this desire to learn as much as possible about the problem of controlling learning, researchers most frequently took an easily stated set of instructional objectives and concerned themselves with the task of controlling the learning of these objectives by creating an instructional program that would lead to their ready acquisition by the learner. An understandable axiom of such research was "an objective that can't be clearly specified should be avoided."

What this has meant in terms of developing an educational technology that has relevance for our schools is that our present research base tells us practically nothing about the process of how to program most of our educational objectives—or even how to state these objectives so that they may be programmed. I realize that to the layman this may seem like an easily accomplished task, and one that is being done all the time but, on the contrary, it is one of the most difficult, most frequently neglected, and critically important aspects of the new educational technology.

The research needed in this area is, of course, not basic in the usual sense, rather it is research that would be devoted to discovering techniques that would enable educators and producers of educational materials to state instructional objectives in a way that would increase the possibility that the new technology can help learners achieve these objectives.

Skill with Objectives

The skill of dealing with objectives in this way is the truly underdeveloped area in the new technology, and it is the research area that contains the greatest immediate payoff for industry and education alike. On the other hand, there are some indications that this problem of stating and preparing instructional objectives may become a major weakness within industry's position. This may, indeed, occur if industry maintains the position that the responsibility for solving this problem rests with the educators.

The all too common reply of instructional technologists to those who have criticized what and how they have programmed has been to say: "If the educators would only state what they want in behavioral terms, we'd be able to program it." Such a position is frequently only a cover for the fact that the technologist is not willing or competent enough to come to grips with any but the simplest of objectives, that is, factual and procedural learning.

Industry can ill afford such an attitude. The attitude that it must take is that the whole area of stating and preparing objectives has been left underdeveloped by educators and the producers of educational materials alike, and that major efforts to make up for years of stating objectives in terms of vague generalizations must be undertaken by both parties. However, I suspect that industry will have to make the first move. After all, it is industry that is doing the selling.

This brings me to another (the third) potential weakness within the new educational technology which paradoxically arises out of two of American industry's great strengths. The first of these is industry's confidence that it can solve any technological problem, given a large enough market to justify the financial investment needed to solve it. The second is industry's ability to see how to deal with problems technologically that seem to defy technological solutions. These undisputed strengths have, indeed, helped to make American industry what it is, and, in the process, make America what it is.

On the other hand, American education (pretechnological and primitive though it may have been) has also played a major role in shaping this country—a role that has been sometimes complementary to and sometimes in conflict with, and critical of, the objectives of industry. Today, as these two molders of our national character meet in the common cause of making better education more readily available to an increasing number of learners, it would be a mistake to attempt to view all of the educational processes as a technological enterprise. Ours is more than just an industrial society.

Whose Responsibility?

Barring a major revolution in educational policy-making throughout all of the 50 states, members of the existing educational community will continue to be the purchasers, the users, and the people with whom the ultimate responsibility for making this new technology work will rest. Yet, these superintendents, directors of instruction, and teachers have not been, nor are they being made, active participants in the design and use of the technology.

The weakness inherent in this situation is as serious as it is obvious. The fact of the matter is that educators are about to be handed the tremendous responsibility of making wise, discriminating use of a new technology that is as confusing and threatening to them as the advent of the automobile was to the owner of a livery stable—for, like the automobile, the new educational technology represents the advent of a totally new, more complex, and faster paced vehicle of education that just might conceivably pass one right by.

We must avoid any possibility of industry and education becoming two sides of a single mold. Given the potential size and educational power inherent in the burgeoning new education industry, it could conceivably become an unprecedented force in American education by contracting directly with local school boards to supply educational services more cheaply and with less bother for the local citizenry than the existing system. Such an arrangement might have seemed fanciful a few years ago, but not only has this been proposed by one educational critic, but the grapevine is rife with rumors of school boards that are exploring arrangements of this type with industry.

Obviously, the implications of this type of reconfiguration within local education are too complex and too far reaching to adequately discuss here, but the very possibility of such a reconfiguration raises the question of the extent to which our existing system of local education and the existing community of professional educators who maintain it bring any unique strength or weakness to the new educational technology.

Given this threatening state of affairs, is it possible that the new educational technology can be strengthened by the existing educational community? Unlikely as it may seem, I believe that the answer to this question is "Yes." It is "Yes" because it is only within the educational community—within the schools themselves—that the new educational technology can be shaped and reshaped to meet our educational needs and objectives. But this potential within the present educational community for shaping the new educational technology is, at present, only a latent potential.

One way of transforming this potential into an active, positive force would be through the establishment of a nationwide network of schools that would contribute product-performance information to a central data source that could be used to assess the pattern of performance of specific products of the new education industry. The system I am proposing would have to constantly gather information that would result in the maintenance of a continuously updated performance profile for each product and class of products.

These performance profiles could in turn be matched to profiles of instructional needs that would be supplied by schools interested in introducing new instructional systems. The proposed product information system would then supply the inquiring school with a list of the available instructional systems that meet his specifications as to instructional objectives, cost, type of teaching pattern with which the system to be purchased must be compatible, et cetera.

In order to increase the chances that both the would-be system and the products it was helping to assess were being used productively, the system would also need to include a program of in-service teacher-training that would offer basic courses in various aspects of the new educational technology. Such basic training would, of course, employ the skills and tools of the new technology. This bootstrap approach could have great payoff by giving teachers and educational administrators firsthand experience with new approaches to teaching and learning.

This type of information and training system would not only help educators become discriminating users of the new technology, but also it would build an efficient corrective feedback mechanism into a new technology being developed largely by a new industry that is dealing with what in many ways is a totally new market. Put another way, such a system would supply the basis for an operational dialogue between producer and consumer that could go a long way toward educating both parties on how to achieve the common objective of using all of our educational tools and skills as purposefully as possible. ☐

Q & A with Ed Tech Leaders

Interview with David H. Jonassen

Susan M. Fulgham
Michael F. Shaughnessy

*In this interview, **David H. Jonassen** discusses his research in problem solving, including how models should differentiate between novice and experts, and how **Problem-Based Learning** can change university teaching. He advocates research that answers the question of what types of learning can be supported with technology. In reference to the third edition of his book **Mindtools**, he recaps that the change process in using Mindtools is through pedagogy and student-centered learning. He explains how learning environmental design relates to tasks, cognitive processes, and a cognitive apprenticeship approach. He responds to the question of constructivism in instructional design for complex and ill-structured tasks and how emerging Web 2.0 technologies will impact learning through social usage.*

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1. What are you currently researching?

Problem solving, problem solving, and more problem solving. More than a dozen years ago, I realized that there was virtually no instructional design literature addressing problem solving. Additionally, the majority of problem-solving research focused on well-structured math and science problems. "Is that all there is?" I wondered. But life is replete with problems. Professional activities are mostly problems. Citizenship requires problem solving. Daily life is full of problems. We need to better understand how to solve problems and to engage and support students in solving real-life problems, not story problems in science textbooks.

To that end, I have developed a typology of problems and am hoping to construct instructional design models for each kind of problem. To date, I have conceived models for story problems, troubleshooting, and policy problems and am working on design problems. I am conducting NSF-funded research on some of these models. Additionally, I have identified the three most important cognitive skills required to solve most problems: analogical reasoning between problems, causal reasoning within problems, and argumentation to justify solutions. I am devoting the remainder of my career to these endeavors.

2. What areas (theory, hard or soft technologies, message design, instructional strategies, etc.) have the greatest impact for change in the field of instructional technology?

Clearly, the field has always been technology driven. The history of our field is best conveyed as a series of bandwagons rolling through the 20th century, each auguring the solution to educational problems of teaching. However, commercial interests have always driven technological development. The only true technology of learning was programmed instruction, and we have seen how much effect it has had on education. We pay lip service to technology being the medium and learning being the goal. The business of education should be learning, but in my academic program, I am the token learning guy, the one who keeps asking what kind of learning we are hoping to support with the latest and greatest techno-solution.

Most of my colleagues in our field are less concerned whether students learn than they are in exploiting the newest toys. Games are a perfect example. Look at any instructional technology conference this year, and games have become the dominant theme. Let's all jump into *Second Life* and create new identities and new worlds. While I do not for a moment doubt the potential of games for supporting powerful forms of learning, I live (for better or worse) in the physical (non-virtual) world, so I'd rather go climb a real mountain than explore a fantasy world. And the problems that plague societies around the world will never find their way into virtual environments. Also, the educational market (with a few exceptions in military and corporate contexts) will never justify the investments necessary to render games with necessary affordances to engage any significant number of learning outcomes. As cool as games are, the overwhelming majority of teachers and professors are still lecturing about the world. And all of the people assimilating into *Second Life* have little concern about what kind of learning is really taking place there. They are too busy trying on their new avatars.

3. Why does the United States continue to lag behind other countries in the areas of math and science?

That's a complex question with no certain answer. The answers are probably embedded in society and culture. Of course, the nature of math and science instruction is generally primitive and atavistic (there are clearly innovative exceptions), but it is no better in other countries, as far as I know. If you are looking for a bogey man, than I would argue for culture. Any culture where Bart Simpson is a hero is not a learning culture. If you examine the standardized test score across the U.S., the group scoring the highest most often is the Asian-American community. That's culture. Learning and achievement are valued more in that culture than in most other American cultures. I have long argued that we cannot reform schools until we reform society, but I am not sure how to do that.

4. Why did you decide to study problem solving? How did the topic capture your interest?

As Karl Popper said in the title of a book of essays, All Life Is Problem Solving. On a personal level, local level, regional level, national level, and global level, our lives are suffused with problems. And while prior knowledge is important to problem solving, it is not sufficient for enabling students to become citizens and professionals who can meaningfully address these problems. Education should do more than fill the silos, because collecting information is meaningless unless we can use it.

Second, there is very little instructional design literature on problem solving. Because problems are so pandemic, we can ill afford to ignore them. Just as I was getting into problem solving, Rob Foshay, then with PLATO, asked me to consult on some new problem-solving software they were producing. I was so intrigued, I even went to Minneapolis in January. In order to provide better ideas, I launched into the study of problem solving. I have been hooked ever since. While I have produced significant literature on many aspects of instructional design, I believe that problem solving will be my most significant contribution.

5. In your mind, in terms of problem solving, what do YOU see as the main differences between experts and novices in terms of problem solving?

There are well-established differences between novice and expert reasoning and problem solving. Experts use a forward chaining form of reasoning, jumping immediately to a solution, while novices use a backward chaining approach, starting with a plausible solution and working backwards analyzing the problem. Experts' solutions are case-based, while novices are schema-based. Novices build conceptual models of disciplines, hanging examples and initial experiences off of their conceptual models. In terms of the Dreyfus and Dreyfus model, as novices accumulate experiences from novice through advanced beginner, competent performer, proficient performer, to expert, their knowledge becomes increasingly case-based (experience-based), so they solve problems by generalizing patterns of cases they have solved previously to new problems. In medicine, we call those illness scripts (schemas). A physician diagnoses by recognizing patterns of symptoms. Unfortunately, firing illness scripts is not always successful. To see why, read *How Doctors Think* by

Jerome Groopman (a physician). You may never visit a doctor again.

Why are these differences important? In our field and especially in the artificial intelligence field, we tend to use an expert model as a goal for novices. Well, the reality is that novices cannot reason like experts or store what they know in any way that is similar to an expert, so why use an expert model? Based on Vygotsky's notion of Zone of Proximal Development, we should use an advanced beginner model for novices, a competent performer model for advanced beginners, and so on, because novices cannot think like experts.

6. What should faculty development centers be doing to prepare faculty to teach problem solving through complex and ill-structured problems?

The former Associate Provost said to me once, "David, you just want every course at MU to be problem-based." I agreed that it was a good idea. Unfortunately, that will never happen for many reasons. Perhaps the most significant reason is inertia (the most powerful force in the universe). Adopting problem-based learning requires fundamental changes in what professors and students do. Change requires effort and new assumptions that do not frequently occur in universities. When working with some engineering professors a couple years ago, I suggested that if they adopted PBL, they would no longer be teaching courses. Some of the faculty members protested, "But that's what we do. We teach courses."

Second, the kinds of change that PBL requires are mostly unrewarded in universities. So, the problem is systemic. Faculty members are rewarded for publishing and securing external dollars for their research because state legislatures (especially in Missouri) don't adequately support the mission of universities. Teaching is not significantly rewarded in universities, so faculty members realize that their efforts are better applied in research.

Another significant impediment to the adoption of PBL is that many faculty are unable to solve authentic, professional problems. Although it sounds surprising, note that less than 25% of engineering faculty members in this country have ever practiced as an engineer (they are not alone). They are highly intelligent people who have never solved professional problems (they design great research studies), so they are way outside their comfort zone if asked to support that kind of problem solving. They simply do not know how. I am sure that they could learn, but if the effort is not rewarded, then it is unlikely.

Fourth, support for problem-based learning is generally not available. Problem-based learning needs to be adopted by all members of any faculty attempting it and must also be supported by the administration. Teaching loads and responsibilities change. There are a multitude of changes that must be made.

For the faculty members who are willing to overcome all of those impediments, they face the wrath of their students for requiring them to learn new study scripts if they try problem-based learning in their classes. Change is just as hard for students as it is faculty. So faculty development alone is not sufficient to engage and support problem-based learning.

I do not wish to leave the impression that PBL is impossible. Quite the contrary. The medical program at the University of Missouri is among the greatest success stories in PBL history. Our medical students went from slightly sub-mean performance on the recall and diagnostic portions of the national medical licensing exams to scores that consistently exceed a standard deviation above the mean. And our students are sought out for residencies, because they know how to diagnose. I am also working with faculty members in nuclear science and mechanical engineering to design and implement PBL courses in their disciplines. There is no discipline that I can think of that cannot be made problem-based. I would love to try out a PBL version of a philosophy course. It might convince students that philosophy pervades our existence and is not merely the purview of egg-headed scholars.

7. How do you address the instructor who states that active learning has no place in his or her discipline?

I have encountered many such faculty. Generally, I ignore them, preferring to work with early adopters. There are many more of them than I can possibly accommodate. If I accepted the challenge of attempting to change the mindsets of atavistic faculty members, then I would begin by asking them what graduates of their disciplines do (unfortunately, many would not know). Then I would ask what they do and attempt to convey the discrepancies between what they do and what learners need. Essentially, I would conduct a needs assessment. Most instructional designers fail to conduct adequate needs assessments. Curriculum designers (professors) in universities never do.

8. It has been a decade since you wrote "Computers in the Classroom: Mindtools for Critical Thinking." What are today's mindtools?

Actually, the third edition *(Modeling with Technology: Mindtools for Conceptual Change)* came out just two years ago. With a conceptual change spin, I argue that among the most powerful ways of engaging radical conceptual change is to try to build a model of what you are studying. Mindtools are modeling tools, each of which requires a different syntax and representation formalism. The Mindtools for the first and second editions are still very appropriate, as are newer ones, such as teachable agents and various conferencing tools. The major problem with Mindtools once again is the change process. Using computers as Mindtools requires significant pedagogical changes along with a student-centered ethos. That does not occur very often. The Mindtools idea, while innovative, is so radical that few teachers or even the publisher of the book support it.

9. What is learning environment design?

Designing a learning environment begins with articulating the nature of the learning that you hope to engage and support. That does not sound too radical until you assess designers' comprehension of learning. I tell my students all the time that "if you are unable to articulate how you want learners to think, then you have no business designing any kind of instruction." Unfortunately, the majority of our Ph.D. graduates do not adequately comprehend learning, so they apply their favorite technology, hoping that learning will occur. As Pogo said, "we have met the enemy, and he is us." Instructional design programs do not require an adequate understanding of learning. While instructional design students may learn to classify learning outcomes according to one or more accepted taxonomies, they typically are unable to transfer those skills into the workplace. Nor do they understand the underlying cognitive processes that are required of those learning outcomes. And because most learning taxonomies describe only discrete skills, they do not understand how those skills contribute to complex tasks, such as problem solving.

There are different conceptions of learning environment. I like Sasha Barab and Tom Duffy's distinction between practice fields and fields of practice. Sasha prefers the latter, engaging students in real-world, emergent tasks. While those are often the richer experiences, they are not scalable, so I prefer the cognitive apprenticeship approach. With that approach, learning environment design begins with an articulation of the cognitive requirements of the task to be learned. (Yes, I am an applied cognitive kind of guy. I have often been accused of ignoring the affective, which is not entirely true, but there is so much that we do not understand about cognition that I feel justified in my unilateral focus.) Then, we create contexts that engage those skills and develop models and various forms of scaffolding to support those skills, and provide different forms of feedback and coaching to help refine those skills. This brief description is an over-simplification of a process that would require a book-length manuscript to describe (see *Learning to Solve Problems: An Instructional Design Guide* for a dated example).

10. What are the implications of constructivism for instructional design, especially for designers who use a system design approach in practice?

That is an emerging question that pervades a new book edited by Sig Tobias and Tom Duffy, *Constructivist Theory Applied to Instruction: Success or Failure?* In a constructivist vs. direct instruction debate engendered by the provocative paper by Kirschner, Sweller, and Clark in *Educational Psychologist*, the issue that emerged from the discussion was how well systematic design and direct instruction can be used for complex and ill-structured tasks. You can use direct instruction to teach only what you can identify and analyze. However, so many problems do not have convergent solutions, methods, or even issues.

The assumption has been that constructivism and systematic design are incongruous. That is not entirely the case. Ill-structured problems are often amalgamations of well-structured problems that are very amenable to systematic design. Additionally, the methods that instructionists use are actually structurally similar to the methods that constructivists use, so we continue to debate a non-issue.

11. What type of skills will instructional designers need in a Web 2.0 world? Web 3.0?

That is a difficult question with numerous possible answers. In order to answer this question, you must examine the ways that technologies are used. The greatest psychological impact of contemporary technologies appears to be social. Students use cell phones and computers to connect constantly with each other. The immediacy and constancy of connectivity along with the emergence of social computing networks like MySpace have resulted in virtual, distributed identities. The necessity of connectivity and the concomitant erosion of personal responsibility brought on by such heavy technology use will have a greater impact on learning than any kind of displays afforded by a bigger pipe.

A bigger pipe will certainly afford the use of newer technologies such as games that require bigger bandwidth, although I am not certain who will be supporting the design and development of those sophisticated technologies for learning (see Number 2 above).

12. Should beginning researchers in the field be using quantitative or qualitative methods?

That is another polemic that distracts us from the important work at hand. The most appropriate research methods are a function of the nature of your assumptions, the nature of learning outcomes, the goals and purpose of the study, and the nature of the research questions. One of the more prominent attacks on constructivism is supported by the lack of randomized, experimental studies showing that constructivist or inquiry learning is more effective than direct instruction. That is such a narrow-minded perspective. The goal of experimental research is the uncovering of universal truths about learning and instruction. The reality is that there are very few truths about learning and instruction that can be universally applied. Learning is contextual and intentional, and it is impossible to know what intentions reside in the minds of learners in different contexts. Also, randomized trials cannot effectively answer the kinds of questions that design-based researchers are asking. On the other hand, qualitative research is not generalizable and is based too often on learner perceptions rather than learning outcomes (not to mention the poor quality of much of the qualitative research that is submitted for publication). Research tools are like most other kinds of tools. They should be selectively applied to meet the needs of the task. I require my students to become well versed and practiced (whenever possible) in both quantitative and qualitative research, and more importantly understanding the assumptions of each.

13. Let's face it. A lot of problems have nothing to do with problem solving, but rather with regulatory, social, or monetary constraints. How do we train problem solvers to deal with these constraints in the real world?

I disagree that problems have nothing to do with problem solving. Constraints are what make problems complex and ill-structured. Most everyday situations are suffused with constraints. In order to decide what to do in any situation with unknowns (i.e., a problem), we engage in different kinds of problem solving. Deciding what to wear is for many people an ill-structured problem that is made difficult by numerous constraints (what is available; what is clean, ironed; weather; activities for the day; contexts in which activities occur; need to impress; etc.). I recently published an article in *Educational Technology* that describes design problem solving (among the most complex and ill-structured kinds of problems) as iterative processes of decision making aimed at constraint satisfaction. I would argue that dealing with constraints in the real world is problem solving. The methods that I use in my research to help learners to identify and deal with constraints include case libraries of stories (case-based reasoning) and the provision of cases as multiple perspectives supported by different forms of scaffolding. The specific methods depend on the nature of the problem (the nature of the outcome) because solving a design problem is quite unlike solving a textbook physics problem.

14. Norbert Jausovec of Slovenia has written about "ill-defined problems" and the need for "divergent thinking." Why do we have so many "ill-defined" problems" floating around, and why do we spend so

little time on divergent thinking?

Well-structured problems are based on theories that describe the world as regular, reliable, and predictable. So story problems in science require students to practice applying those reliable theories. When the theory is regular and reliable, the problems always have correct, knowable answers. Unfortunately, any time you begin to apply theories in everyday contexts, the theories begin to unravel. The overwhelming majority of problems that we face in personal and professional contexts do not have a known answer. There are almost always multiple answers or quite often no answers at all. You cannot apply any single theory to figure out how to stop genocide. So Jausovec (I presume because I am not familiar with his work) claims that we need to engage in divergent thinking in order to face problems with multiple or no answers. My belief is that rather than divergent thinking (whatever that is), we need to learn to think systemically in order to better address ill-defined problems. That means looking not only at what we do and how it affects someone or something else, but also how someone else affects us and others. We need to examine problems first from what Barry Richmond called a 10,000 meter view.

Let's examine the interconnectedness of systems and how our activities affect those other systems. A perfect example (not one that is popular in Indiana, where I grew up) is the ethanol debacle. In order to gain energy independence (an illusive concept at best), we encourage farmers to grow more corn and require gasoline to be mixed with ethanol, despite the fact that sugar cane is a much richer bio-fuel and the cost of producing ethanol exceeds its price and, oh, by the way, if all the corn is used to make ethanol, what might happen to the price of food worldwide? It's remarkable to me that Congress was surprised and that no one there anticipated those systemic effects.

15. We would like to discuss, the word "intelligence" and its role in learning styles and processing. It seems that this factor—intelligence or cognitive ability—seems to loom precariously on the frontiers of our research, yet few discuss it extensively. Why do you think this is?

Intelligence is a complex but essential predictor of learning. Intelligence and prior knowledge account for most of the variance in learning. Most scholars accept that intelligence is more than the g-factor that can predict all kinds of learning. There are clearly multiple forms of intelligence. Gardner's Multiple Intelligences is a good metaphor for describing some of these different kinds of intelligence. The factor analytic studies conducted by Thurstone and Guilford after World War II attempted to empirically identify many of those kinds of intelligence (Guilford found nearly 110). An empirical goal might be to associate each of those forms of intelligence with different learning outcomes, but that would require more effort than any agency is willing to support. Some of the most impressive work that I have read was conducted by Gavriel Salomon, who articulated specific forms of intelligence and associated them with specific learning outcomes. Great stuff, but he didn't approach 110. That research went out of style along with most aptitude-treatment interaction research.

In order to make intelligence more accessible, educators have derived cognitive styles and learning styles to explain individual differences to other educators. Those styles describe self-reported preferences for interacting with and extracting information from the environment. They are also good metaphors for getting educators to think about the role of individual differences in learning, but they are not (I believe) rigorous enough to use in empirical research on learning. Why isn't intelligence examined more carefully in our field? As I stated in Question 2 above, so few researchers in our field are really interested in learning. They are for more committed to the technology.

16. You have indicated that it may be cheaper to "deliver" knowledge over the Internet, but it will not be more effective. What do you see as the long-term ramifications and repercussions of delivering knowledge over the Internet?

Knowledge cannot be delivered via any medium. The epistemological assumption underlying knowledge delivery is the bane of our entire educational system. We tell students what we think they should know and assume they will know it too (very wishful thinking). Universities around the world are using the Internet to deliver content for economic reasons, not for the pedagogical superiority of online programs. Although online programs have the potential of engaging more meaningful learning, that becomes another significant change problem. In the education culture, online courses are generally perceived as easier than face-to-face. Regardless of the reasons for such a perception, the effects are lamentable, especially if we are unable to change the perceptions.

17. Could you outline the main points of A Manifesto for a Constructivist Approach to Technology in Higher Education?

The solution is easy: Problem-based learning. Implementing the solution is very problematic.

As educational technologists, we must carefully examine the roles that technology plays. I have argued for years that technologies should be used as tools for constructing external models of internal mental models. Technologies should also be used to create rich environments that require complex thinking. Technologies should be used to scaffold the ways that we think. Unfortunately, technologies are most commonly used to deliver content (see previous question).

18. In some of your other interviews, we have seen that your guidance to others is to "avoid bandwagons." Why do you offer this advice, and why do you think it important to avoid jumping on the latest bandwagon?

Because bandwagons engage shallow understanding. They resemble our presidential campaign, where sound bites dictate perceptions and candidates are afraid of confronting the American public with the truth (or at least an alternative version of it) about how our country is functioning or how it could or should function, for fear of offending some portion of the populace. The history of our field is replete with bandwagons, new technologies that were the temporal panaceas for the problems of education. Bandwagons are solutions in search of problems. Has any educational technology substantively changed the ways in which we educate students over any significant period of time? Has any educational technology dramatically altered the ways in which students learn or how effectively they learn? Have learning outcomes (other than high-stakes testing) ever driven the development and implementation of new technologies? □

Interviews
with
Badrul Khan

E-Learning in Iran: Interview with Vafa Ghaffarian and S. Hamid Hosseini

As a student in Bangladesh during the 1970s, I used to dream about having access to well-designed learning resources, available at that time to those in industrialized countries. In the '70s, it was unthinkable to have equal access to such resources. In the '90s, with the emergence of the World Wide Web, my dream of equal access to quality learning resources became a reality. Since the publication of my ***Web-Based Instruction*** *book in 1997, I have been researching the adoption of the Internet and digital technologies in delivering education and training worldwide. In this issue, we introduce to the reader two leaders in e-learning in Iran.* ***–Badrul Khan***

Badrul Khan: *The world has changed a great deal when it comes to education and training, with emerging and advanced technologies. New technologies have tremendous impacts on the educational development of a country. How is it in Iran?*

Vafa Ghaffarian: You can witness a similar situation in Iran. E-learning started in Iran in 2001, when Tehran University launched nine of its courses online. Nowadays, almost all universities are presenting some courses on the Internet, besides technical fields; even religious-based universities educate their students by employing these technologies. We should add tens of small training centers (such as **sadegh-net**) to this list.

S. Hamid Hosseini: As in many other countries, Iran has been affected greatly by the spread of ICT. Although there isn't enough technical and cultural infrastructure in Iran, as there is in some developed countries, there is high enthusiasm to employ ICT, and there have been considerable efforts in this regard. Currently, preparation for e-learning is ongoing, and many universities as well as religious educational centers are offering courses, providing the chance for students all over the nation to be educated in desired fields. Levels of education are different, though, and in some cases big leaps are required to achieve optimum potential.

BK: *People who are used to traditional classroom-based educational systems may find it difficult to adapt to new ways of learning through technology-enriched learning environments. It requires a tremendous effort to change people's mindsets for a change which may not have shown any positive impact as yet. You have been pioneers in e-learning in your institutions. Please share your experiences with e-learning in this regard.*

VG: There are some people emphasizing face-to-face advantages. We have found that a blended approach (a mix of online and class-based courses) is a good solution as a transient phase. Highlighting the satisfied student's opinion online is an effective way to motivate others to enter online courses. You know, we are building a new learning paradigm, and it requires time and effort to reach fruition.

HH: The solution offered at the Hadith Sciences College (Hadith are oral traditions relating to the life and words of the Prophet Muhammad) to confront the issue is to team

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Badrul H. Khan*, a Contributing Editor, is Founder of* ***McWeadon.com*** *(a professional development site) and* ***BooksToRead.com*** *(a recommended readings site on the Internet). He is an international speaker, author, educator, and consultant in the field of e-learning and educational technology (e-mail:* ***dr.khan@mcweadon.com****; Website:* ***http://BadrulKhan.com****). His most recent book is* ***Flexible Learning in an Information Society****.* *Dr. Khan acknowledges the assistance of Dr. Kamran Etemad Moghaddam of the Industrial Management Institute, Mr. Emad Ghaeni of RayaZeytoon, and Dr. Mahnaz Moallem of the University of North Carolina–Wilmington, with this interview.*

Dr. Vafa Ghaffarian *is co-founder of Sadegh-net (****www.sadegh-net.com****) Institute, one of the leading institutions of e-learning in Iran. Dr. Ghaffarian is also chairman of Telecommunication of Iran (TCI), the largest company in its field, and consults with large organizations on strategy. He is an assistant professor and has taught university courses on Strategic Management and Thinking.*

S. Hamid Hosseini*, President, Hadith Sciences Virtual University in Iran, of the Iranian Hadith Sciences College, is one of the proactive professionals in the Iranian e-learning community. He graduated from the Qom Islamic School in religious science and does research on Hadith and Islamic thought and methodology. He has set up a number of Websites to promote religious scholarship.*

an experienced professor with a high-profile e-learning assistant. The assistants are well aware of educational goals and are responsible to produce content and deliver the presentation of the course. Meanwhile, observing outcomes, success, and student willingness, professors have been accepting the electronic method and have attained more readiness to cooperate. There should be no hurried action. However, right decisions and actions in production and presentation of e-learning facilitate the process. Publicizing best practices and achievements is a useful strategy. We must not involve in e-learning those people who assume that the computer and software can replace *all* aspects of a university and educational services. This approach causes diminished educational support. Results are obvious; no such system can be successful in the growth of students, and mistakenly, the e-learning concept will be held responsible for failure.

BK: *Do you think e-learning can be used to offer courses in all subject areas? Can technical courses be delivered online? Please comment on the pedagogical approach you prefer for online learning. It appears that students must learn on their own and from readings and lectures and possibly participating in discussion. How can they apply such methods to hands-on fields, where there needs to be a lot of demonstration and applications?*

VG: E-learning is more efficient in transferring knowledge rather than skills. Although engineering and nursing science students may be educated by e-learning, we face many shortages when it comes to practice. As a solution, a blended approach may offer the benefits of both virtual classrooms (for knowledge development) and physical field work (for skill improvement). The rapid development of e-learning technology and methods, and decreases in their limitations, also should be taken into account,

HH: There are advantages and disadvantages to any educational approach, as is true in traditional ones. E-learning has unique advantages of its own. I believe the more we employ e-learning tools and experiences, the more we can find solutions to increase efficiency of the methods. Consequently, the number and variety of courses offered will increase as well as their quality of presentation. We have focused our investment on content production in the study of Hadith, and we produce courses of the highest quality. The process involves restructuring content, numerous evaluation steps, and scientific control, exploiting advanced multimedia and studio tools to deliver concepts.

BK: *Do you envision that someday you will offer e-learning courses from Iran to other countries in the world and vice versa?*

VG: It's our certain vision, which directs and motivates our people inside **Sadegh-net**. There is not a day or night which I don't think about this issue.

HH: Yes, right now a number of students studying Hadith with us come from other countries. Also, we have set up an e-school in Arabic to respond to the great enthusiasm to learn Islamic science, targeting Arabic-speaking countries.

BK: *E-learning is gaining a great deal of attention in Iran. I was recently invited to deliver a keynote address via video conferencing at the International E-Learning Conference in Iran. This shows an increased interest in e-learning in Iran, with international participation for the conference. Do you see collaboration of e-learning projects among Iranian e-learning professionals and international experts to explore, discuss, and learn about the best ideas for e-learning?*

VG: Certainly I do. Prior to scientific projects, though, I believe that it should be started as a business partnership. Otherwise, it may not last, as you would expect.

HH: International communication is ever-increasing, thanks to the environment of ICT and the blur of geographic borders, and there is still more potential for that. We have established connections with experts in other countries and benefit from their consultancy services.

BK: *In researching the question of "What does it take to provide meaningful e-learning environments for diverse learners?" I found that there are many of issues critical to the development of meaningful e-learning. My research has shown that these issues encompass eight categories, including pedagogical, institutional, technological, interface design, evaluation, management, resource support, and ethical considerations* ***(http://BadrulKhan.com/framework)****. I would like to hear your thoughts on any one of the eight categories of issues for the successful design of e-learning in Iran.*

VG: These are some key factors that should be considered cautiously when it comes to e-learning. The pedagogical issues are the most important ones; I believe these can multiply both the effectiveness of learning and satisfaction of learners. If we want to look at this issue from the angle of technology, I think that having knowledgeable people on the ground in the target market is more important than the technology itself. If I want to add one dimension to your octagonal model, I think the Cultural dimension would play a key role too. It can act as a powerful barrier or supporter.

HH: In all areas mentioned, there are fine initiatives in Iran, but technical issues attract the most attention, even though all items are of equal importance. We do our best to clarify the importance of all items for Iranian decision-makers and students, starting and developing from our own school. Holding scientific conferences with e-learning has had a considerable effect on a more scientific look at the topic. In all universities, we have an e-learning department; but there is a spot open in the ministry of higher education. There needs to be more scientific investment in the field.

BK: *As e-learning is becoming more acceptable in both academic and corporate settings in Iran, It is expected that more and more Iranian institutions will invest in e-learning for education and training development. To develop new learning environments with new technologies, many of these institutions would require professionals with e-learning instructional design skills to assist in e-learning production. Do you see an increasing demand for e-learning* *professionals in Iran? If such a demand exists, who is responsible for preparing such professionals? Do you see any opportunity for US universities and the US e-learning industry in the e-learning development in Iran?*

VG: I see e-learning as a new formation of existing sub-systems to make a new system. It means that the key building blocks of e-learning are available, but it needs a new architecture to be made (institutional issues in your model). So the most important necessity for fast development of e-learning in Iran is people who make the big picture (the managers in your model). The partnership with foreign universities and learning industry would be meaningful if they focus on the total system rather than sub-systems. Being meaningful they must fill gaps, not delete the existing local potentials.

HH: E-learning development in Iran is definitely dependent on providing expert human resources and instructors, and enough attention has not been paid to it. There have been initiatives in Iranian universities, yet there is a long way ahead. One of the best ways to fill the gap is to attain help based on the experiences of universities all over the world. □

Author Guidelines for Magazine Articles

In preparing an article for Educational Technology Magazine the primary fact to keep in mind is that this magazine is not a formal research journal. It is, as the name implies, a magazine. The Editors are looking generally for articles which interpret research and/or practical applications of scientific knowledge in education and training environments.

Thus, your article should not be cast in the form of a traditional research report. The facts of your research, or that of others, should be stated succinctly. Then you should go on to explain the implications of this research, how it can be applied in actual practice, and what suggestions can be made to school administrators, trainers, designers, and others.

The style of writing should be on the informal side—an essay—since once again this is a magazine and not a formal academic journal. Authors are free to state their opinions, as long as the opinions are clearly identified as such. The use of specialized jargon should be kept to a minimum, since this magazine has a very wide interdisciplinary audience.

There are no minimum and maximum length restrictions. Make your article as short as possible to do the job you intend. As a general rule, most articles are about 3,000 words. Include graphics as appropriate.

Note too that this magazine is read in more than 100 countries, by persons holding prominent and influential positions. They expect a very high level of discourse, and it is our goal to provide major articles of excellence and lasting significance.

Point of View

The Curious Case of the Polio Virus Learn Node

Judy Breck

Why would my *Learn node: Polio virus invades from cell into the gut*[i] get 2,077 on-site views in the first eleven months of 2008, while the next most popular learn node in my collection, about Winston Churchill, got only 734 on-site views? The number of on-site views for my learn nodes drops rapidly after Churchill: lady bugs as green troops, 424, Zac the Rat teaches the letter "A," 338, helmets that prevent brain damage, 327, meerkat facts, 291.

And would you not think that the general online public would be more interested in lady bugs and meerkats, surely—and Churchill, helmets, and phonics, probably—than a polio invasion of the gut?

The popularity of my polio virus learn node is even more curious when you realize that it is bundled inside of course materials and made up of slides, numbers 26 and 28, deep inside a PDF that is inside of course materials. The exact location of the curiously popular polio virus learn node is Johns Hopkins Bloomberg School of Public Health Open Courseware for course *550.630 Public Health Biology*.[ii] To reach it online, you need to go to that courseware and download *Module 2: Pathogens and Host Immunity*, open *Lecture 3: Pathogens: Nature and Transmission*[iii] —where the slides are inside.

The Learn Node Method

My learn node project was put online in the fall of 2007. It operates from a WordPress blog titled Learnodes.com[iv] where I launch blog posts called *learn nodes* with the specific goal of driving Internet traffic to open educational resources (OER). The learn nodes posts are designed to be landing pages that will acquire Internet visitors who are searching online for the topic of the learn node. The goal is for these visitors to land on the learn node and then click through it to quality OER learning pages I have selected and linked out from the post.

We will return to the question of why my polio virus learn node received so many visitors compared to the dozens of other learn nodes I launched over the past year. First, a look at how well the learn node method works. Once visitors were attracted to the polio virus learn node, did they click

***Judy Breck**, a Contributing Editor, writes about online learning on her blog, **GoldenSwamp.com** (e-mail: judy breck@gmail.com).*

through to the OER resources I had linked to the post? The answer is yes.

Of the 2,077 on-site visitors to the polio virus learn node, 330 clicked through to the Johns Hopkins Web page where the PDF could be downloaded to access the slides featured in the learn node. That is a very high click-through rate of almost 16%. The polio virus learn node also links to a Public Library of Science Biology article: *Imaging poliovirus entry in live cells,*[v] and to a *Virology Journal* article: *Epidemics to eradication: the modern history of poliomyelitis.*[vi] Those articles received 30 and 25 click-through, respectively.

In an October 2008 interview, responding to a question about mobile phone access to the Internet, Howard Rheingold described education dilemmas that learn nodes are geared to solve:

> All of the world's knowledge is in the air to be plucked down by our telephone. Of course it's also all the world's disinformation, misinformation, spam, porn, Nigerian frauds, urban legends, hoaxes. So how do you find what you want and how do you know that it's true? Those seem like to me both extremely important questions today.…[vii]

My learn node helped people find what they wanted. The placement of three prestigious sources together on the learn node helped them to know that they would be clicking into reputable—true, to use Rheingold's term—educational resources.

My polio virus learn node worked very well in attracting visitors to quality OER that satisfied their quest: Visitors came and a high percentage clicked through to the OER I had chosen for the topic. The learn node concept and the methods I used to attract visitors are borrowed from search engine optimization (SEO), now a series of fundamental tools for online commerce. A major thrust of the *Learnodes.com* project is to demonstrate that SEO can work for OER—that open educational resources can be optimized for search engines to attract visitors. In Rheingold's language again: SEO can help you find what you want and know that it's true.

Part of the curious fact that the polio virus learn node had so many visitors compared to my other learn node offerings is, I suspect, that I did the SEO better for the polio virus post. I must have stumbled on to keywords that made the learn node attractive. There was probably some social networking that helped. Educators are beginning to learn that they need to add SEO to their resources. I am among those who are working at understanding SEO and becoming more competent in practicing it.

Unbundling

For a fuller look at this challenge, we need to notice that the tiny size of the polio virus learn node tells us something important about SEO. The most popular of my learn nodes, as noted above, is located way down inside a bundled course, and there it is no more than a couple of slides inside of a PDF. When I created the polio virus learn node, I copied the wonderful images on the slides and used them to illustrate the learn node post that I put online. In the text of the post, I made it possible to click to the PDF where the slides were, and explained how to locate the images within the PDF.

This willingness for online visitors to unbundle content requires an off-putting amount of effort, one would think. Not so. In a network environment, unbundling makes subject content nodes available on their own, and visitors like that.

Spontaneous unbundling is happening to many kinds of Internet content. An example from the hit TV show *Saturday Night Live* appeared in a post-Presidential election report, TV *Breaks Out of the Box*[viii] in the *Washington Pos*t:

> When Tina Fey debuted her impression of Sarah Palin on "Saturday Night Live" last month, more people watched the comedy sketch online at NBC.com or Hulu.com than during the show's broadcast.

The television program received fewer viewers than a small segment of the program received online. The fact that viewers can select a node to watch from inside an entire television episode is a network structural fact likely to massively reconfigure the TV industry — as it is essentially all other analog content that has migrated online. Nicholas Carr, who in a chapter called "The Great Unbundling" in his book, *The Big Switch*,[ix] describes the effect on print publishers:

> The publisher's goal is to make the entire package as attractive as possible to a broad set of readers and advertisers. The newspaper as a whole is what matters, and as a product it's worth more than the sum of its parts. When a newspaper moves online, the bundle falls apart. Readers don't flip through a mix of stories, advertisements, and other bits of content. They go directly to a particular story that interests them, often ignoring everything else.

E-commerce is way ahead in the unbundled content game, letting online shoppers zip in a click or two to exactly the pair of sneakers or book they want. Education has not thought as much about unbundling its subject matter, too often leaving teachers and students to work from tightly bound courses, standards, or curricula.

Hairball Structures

Although unbundling is a useful word to describe the way networks deal with packaged content from the analog past, the word *hairball* tells us more, as you can see in the structures illustrated in ***Figure 1***. I found the word hairball used in a 2008 paper, *The art of community detection*[x] by Natali Gulbahce and Sune Lehmann, from the BarabasiLab.[xi] The illustration is adapted from that paper, and used with Ms. Gulbahce's permission. The left half of the graphic is from the article and illustrates "the scales of organization of complex networks…and shows how to breakdown the 'hairball' that arises when we plot the entire network." I have added the right half of the figure to indicate how different portions of a piece of OER might fit into the steps of the breakdown of its hairball.

In the view of network science, it is not at all curious that online visitors are inclined to burrow into a hairball to locate a specific node. A network hairball scales from local to global structure, providing structures between for content at every scale.

A course such as *Public Health Biology*, where the polio virus learn node is lodged, is an enormously useful link for someone who is teaching the subject, and often for students

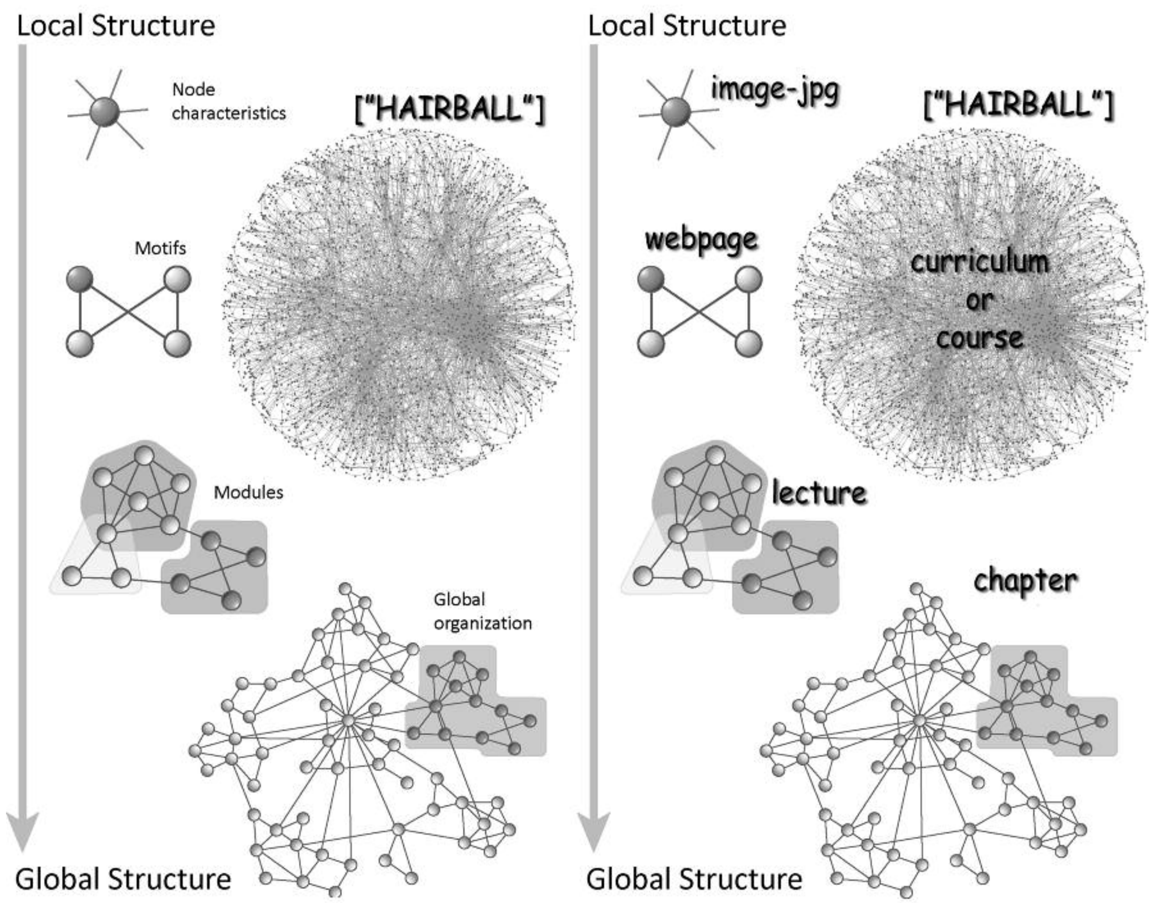

Figure 1. Hairball and its scales of organization.

as well. Its potential online is greater still. Its course materials can become a rich hairball network: many of the components within the course will be useful OER for many others not needing all, or any other, of the course assets.

The term hairball is helpful in understanding and overcoming the usability problems of curricula materials when they are put online. Now that educators have had several years of experience—and a good deal of frustration—in attempting to shoehorn educational materials into the Internet, the explanation and guidance of the network breakdown chart are timely. OER placed online as a curriculum or a course creates a hairball that needs to be unbundled. The educational value of that hairball is increased exponentially by liberally identifying lower-scale parts with URLs, and providing search engine optimization at each of its scales: nodes, motifs, modules, and the community (hairball).

As to the reason my polio virus learn node received so many visitors: The truth is that we do not know—yet. As educators, we should be curious enough about what is happening to our content on the Internet to make finding out and using what we learn a top priority. If Nike can send you to a specific shoe in a couple of clicks, and Amazon present you in a nanosecond with six books you covet instantly, we can figure out how to send students with equal facility to the right places to educate them well. Be curious about how to do that. □

Notes

[i] *http://www.learnodes.com/2007/09/03/polio-virion-released-into-the-gut/*

[ii] *http://ocw.jhsph.edu/courses/PublicHealthBiology/index.cfm*

[iii] *http://ocw.jhsph.edu/courses/PublicHealthBiology/lecture Notes.cfm*

[iv] *http://www.learnodes.com/*

[v] *http://biology.plosjournals.org/perlserv/?request=get-document&doi=10.1371/journal.pbio.0050183&ct=1&SESSID=24b1e973282ed90b387211c3c43de82b*

[vi] *http://www.virologyj.com/content/4/1/70*

[vii] *http://vimeo.com/2018287?pg=embed&sec=2018287*

[viii] *Washington Post*, November 16, 2008. *http://www.washingtonpost.com/wp-dyn/content/article/2008/11/15/AR2008111500190.html? hpid=topnews*

[ix] Nicholas Carr, *The Big Switch*, W.W. Norton, 2008, p. 153.

[x] Natali Gulbahce & Sune Lehmann. *BioEssays, 30*(10), 934–938 (2008). *www.barabasilab.com/pubs/CCNR-ALB_Publications/200809-17_BioEssays.../200809-7_BioEssays-CommunityDetection.pdf*

[xi] *http://www.barabasilab.com/*

Looking Ahead Looking Back

Denis Hlynka

"Just do it"

It's one of the definitive commercial slogans of our time: "Just do it." The phrase entered the popular lexicon of the late twentieth century. It seems to capture the spirit of our times. All to sell a running shoe by Nike.

There is an opposite slogan that is not so popular anymore. Indeed, the younger generation may not even have heard of it. When I went to school, we learned with the help of a series of readers, accompanied by workbooks. The workbooks were called *Think and Do* books. It is a title that should give us pause. It almost cries out as a challenge to Nike, and seems to say: Stop! *Think* before you do! Or, reading it differently, the *and* can be seen as a conjunction, asking us to think and do, simultaneously. However one reads it, the additional word *think* stands in contradistinction to Nike's *do*.

Lest one think that the two slogans are not fairly compared, since one is an advertising slogan while the other is for educators, here is an advertising slogan advocating the same "slow down" message as "think and do," albeit with a different focus. Early Coca Cola ads advertised their product as "the pause that refreshes."

We don't like to pause much any more. We are too much in a hurry. Radio and television are still deadly afraid of a pause when "on air" and have dubbed such space as "dead air," obviously something to be avoided. So, often in the middle of a serious, sobering newscast, we are no longer surprised or affected when after a report of a horrendous event, we are immediately confronted with a jolly commercial telling us to take some new pill or to try a fast-food hamburger. Never mind that we are an over-medicated society. Never mind that the hamburger is adding to the growing obesity problem globally. If it sounds good, "just do it."

Recently, my own university jumped on the "just do it" bandwagon, with their latest catalog of online courses. The catalog advertises "degrees on the go," and shows a blurry photo of people in a hurry. But if you want a degree…no problem. You can catch it "on the go" without missing a beat.

The Educational Technology Connection

Educational technology is without doubt especially susceptible to the "just do it" syndrome. It comes in at least two forms. First is the hype that accompanies any new medium, followed by a rush to integrate it into education. The traditional "diffusion of innovations" model used to be that of Everett Rogers, in his 1962 book, *Diffusion of Innovations*. That is where he suggested that innovations pass through the five stages of knowledge, persuasion, decision, implementation, and confirmation. This was also the model that introduced concepts such as *early adopters*, *innovators*, and *laggards* into the vocabulary of educators everywhere.

The problem with this model is that its assumption is positive. This is a model for the optimists; this is a model for the technophiles. But, innovations are *not* always successful. This model needs to be countered by an opposite model. Since I cannot find any such model in the literature, let me present my own very tentative dysfunctional model of six stages of technological innovation, as shown in ***Figure 1***.

Extravagant claims
Mass purchasing
Non-training
Misuse
Non-use
Rejection

Figure 1. Hlynka's dysfunctional model of technological innovation.

In other words, through advertising, hype, and marketing, we are presented with extravagant claims of a new medium. This results in mass purchasing, which most often is followed by non-training, on the assumption that the functions of the new technology are *self-evident*. Non-training leads first to misuse, then to non-use, and finally to rejection of the innovation. The model then recycles. The next new technologies are grabbed off the conveyer belt. They just keep coming.

The model is, of course, tongue-in-cheek. Hopefully, as a model, it fails, because there are *no* such cases or exemplars. Or at least there shouldn't be. Yet, what if it were true?

Interestingly, recently a new model of innovation has surfaced which actually does recognize that technological progress is not a linear straight line. Indeed, it recognizes the power of media hype in its very title: The Gartner Hype Cycle. The Gartner Hype Cycle was introduced by Gartner, Inc., the information technology research advisory company, and provides a useful alternative to the Rogers model. It recognizes that dissatisfaction is a natural step in any innovation cycle. To "just do it" is to fly in the face of the reality that follows initial excitement.

The Gartner Hype Cycle's five steps are technology trigger, peak of inflated expectations, trough of disillusionment, slope of enlightenment, and plateau of productivity. Note the curious word "disillusionment" and the phrase

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"inflated expectations." Both provide a useful cautionary pause ("the pause that refreshes"?). Jeremy Kemp has rendered the model in graphic format (see ***Figure 2***).

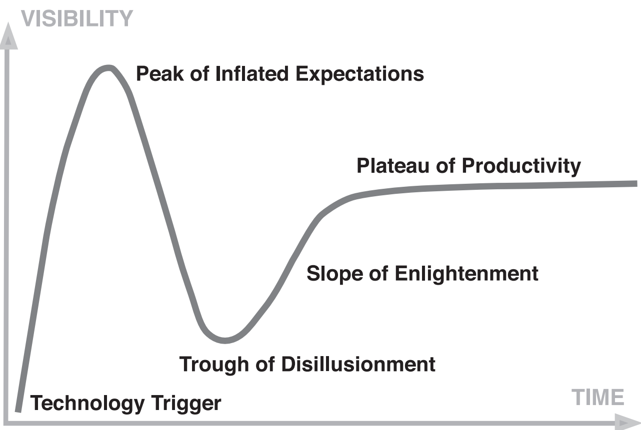

Figure 2. The Gartner Hype Cycle. Retrieved from Wikipedia: *http://en.wikipedia.org/wiki/Image:Gartner_Hype_Cycle.svg* .

Ultimately, the Gartner Hype Cycle culminates in what is sometimes called "mature technologies." Importantly, a mature technology is one that is considered to be user-friendly for all. One need not be an expert or technology guru or even a technophile. In short, the Gartner Hype Cycle suggests that one indeed does *not* "just do it." To "just do it" may well leave one at the very top of the "peak of inflated expectations," on the brink of falling into a deep "trough of disillusionment." In education, it happens all the time!

A Curious Observation

When one discusses universal acceptance and/or rejection of a technological innovation, there is one exception that the models above do not explain. Many of the new technologies have indeed been accepted in society. Only in the field of education have they been rejected. Radio today can be found in every home and car. Radio cannot be found in classrooms any more, notwithstanding a huge effort in the 1950s and 60s. Television likewise is ubiquitous. Former single-channel towns have become 100 channel universes. The penetration rate of television is nearly 100%.

Yet in the classroom, television sets with accompanying DVD/video players are relegated to one or two per school, usually on a cart, to be rolled in when required, which is seldom. The promise of programs like "Continental Classroom" of the 1960s, where the best teachers could reach students from coast to coast, is long dead. Coast to coast transmissions are reserved only for football games, reality shows, talk shows, and entertainment. Not education. Not the classroom. Just because a technology is diffused throughout society, this does not mean that it will automatically impact pedagogy.

"Standards" Tell Us How to Do It

There is a second way in which educators are coerced into a "just do it" syndrome. This is the current trend towards accountability that is seen in a plethora of state, provincial, and national "standards." Nearly every country is getting onto the "standards" bandwagon, and the domain of technology in education has not come through unscathed. Dubbed ICT, a shorthand for information and communication technologies as tools, in the USA the International Society for Technology in Education has led the way with major competency lists of "what every teacher should know" and "what every student should know" about technology: *http://www.iste.org/AM/Template.cfm?Section=NETS* .

The standards movement is a valiant attempt to capture what teachers need to know about technology, and what students need to know. In addition, instructional materials need to be grounded in curriculum standards.

The standards movement is extremely controversial. Those who are supportive argue that it provides clear guidelines that lead to accountability. Those who disagree with the standards movement argue that standards, for all their good intentions, turn out to be either so constraining, on the one hand, or so vague, on the other, that they don't provide any explicit direction anyway. Opponents to standards also point out that standards are inherently political, and that standards are essentially a top-down model imposed by those in power. Teachers are expected to learn the model and than apply it. In other words, "just do it."

Raymond Horn (in *Standards Primer*, 2004, Peter Lang Publishers) is one of many who questions the standards approach. He argues that there are two essentially different categories of standards: technical standards and standards of complexity. Technical standards are those grounded in a belief that there is an objective reality that can be identified and classified. This is the usual approach to standards and assumes that one can first identify what students need, and then arranges them in some sort of categorization.

ICT competencies look good from a distance, and have the advantage of being easily gradable using a checklist or a rubric. But they fail on several grounds. Most important, who makes the decisions as to what content or skills are necessary or useful?

Horn calls his second category standards of complexity. Applying the standards of complexity to technology, says Horn, means an examination of technology as a move from technology as "uncontested and neutral purveyors of information to resources that are critiques through the use of higher-order thinking skills" (p. 101). He argues that "in standards of complexity classrooms, all the information provided by textbooks, supplemental materials, computer technology, videos…are critiqued to uncover the assumptions, representations, and consequences of the way the resources are organized in the content that is presented by these materials.…No resources are privileged." *(Ibid.)* By this model, students and teachers are no longer simply following a rubric of what to do, but are critically asking *why*.

In other words, there is more to developing a standards list than merely making a list, "checking it twice," and then requiring an unquestioned compliance to these steps. Typically, in the technical model of ICT standards, teachers are not asked to think about and critique the implicit model; rather, they are usually told that they must implement these imposed standards and criteria, usually by a certain date. In other words, once again, "just do it." This is one reason why teachers so often balk at the idea of standards-based teaching.

Hype and Rhetoric

The "just do it" model celebrates hype, rhetoric, and spin. Educational technology used to argue whether it should follow a business model or an educative model. The one focuses on standards and an objectives-based approach, while the latter focuses on a "liberal arts" model. Today, there is a third model that has wormed its way into our sensitivity: the advertising model. The advertising model is neither interested in thinking about educational technology integration (standards-of-complexity) nor even a pre-conceived list of what one is expected to do (technical standards). The advertising model short-circuits both of these and asks us simply to "just do it."

Conclusion

Society has moved from a "think and do" mentality to a "just do it" mentality. The consequences can be seen in the field of education and very clearly within the domain of educational technology. We need to put the "think" back into the equation. It is time to go back to those times when students and teachers were asked to think *and* do. ☐

Q & A with Ed Tech Leaders

Interview with Diane Gayeski

Michael F. Shaughnessy
Susan M. Fulgham

Diane Gayeski *shares her research on the impact of communication on learning and organizational performance, predominantly with Millennials or "Nexters." She reflects on the characteristics of those who are in higher education and entering the workforce, and explains what corporations must do to attract and profit from their diverse skills. Using examples of how new media are used in her company, Gayeski Analytics, she discusses how online group-ware, wikis, and mobile devices can compel change in how communication is used to strategically improve training and delivery of information. Dr. Gayeski also shares how to effectively defeat information overload through design and the future integration of technologies. She concludes the interview by reflecting on the changing face of business communication, where everyone is a* ***driver****.*

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Diane Gayeski *is currently Interim Dean of Graduate and Professional Studies at Ithaca College, where she also continues as Professor of Strategic Communication and teaches in their graduate program. She maintains a consulting practice through her firm, Gayeski Analytics, and she is also an adjunct graduate professor in Boise State's online master's degree program in instructional and performance technology. She is a Contributing Editor of this magazine (e-mail:* ***gayeski@ithaca.edu****).*

1. What are you currently writing about or researching?

My research agenda has always explored the intersection of various forms of communication as it impacts learning and organizational performance. Currently, a lot of my writing and consulting centers on the attitudes, values, and communication preferences of the upcoming generation of Millennials—and how organizations can better design effective recruiting, selection, training, retention, and performance management strategies to maximize their human capital. I'm also involved in researching and developing courses on virtual teams and collaboration software, and how both of these can be used to improve strategic planning and design.

2. You are known as a pioneer in interactive media. What is the interactive media of the future?

I believe that we'll continue to see integration of technologies onto mobile platforms that will leverage current capabilities, such as context and location awareness, personalization, and enhanced capabilities for users to not only be passive 'receivers' but active 'producers.' Wearable computing devices will enhance our ability to deliver training and performance support to people as they interact in their everyday work or play environment: this includes technologies such as eyeglasses that serve as 3-D monitors, voice recognition, body movement sensors, and so on.

3. What are "Nexters" and what should college educators know about them?

"Nexters" (a.k.a. "Millennials" or "Gen-Y") are the young generation who are currently in their teens and early to mid-20s. Perhaps the most important things to realize about them is that they have vastly different skills and preferences in the way that they seek and make sense of information. While the previous generation was very influenced by television—especially educational TV shows like Sesame Street—a large percentage of Nexters have spent more time on computer gaming and information surfing than watching TV. They have learned how to negotiate complex and vague problems, to seek information from various sources including other kids around the world in a virtual environment, and to learn in teams. They are used to being active collaborators—but they also welcome direction from professors and supervisors, and they also tend to seek frequent direction from their parents and peers. This generation is capable of assimilating information quickly, and they are eager to solve problems that impact society. While keeping pace with what seems like a limited attention span can be a challenge to professors and corporate trainers, we can leverage their skills and motivations to bring about higher achievement than we've previously expected of young people.

4. What type of innovation strategies are organizations using to attract "Nexters"?

Nexters seek work/life balance and meaning in life. The most successful organizations in attracting the most talented Nexters make this possible through policies and programs that promote learning and new experiences, allow them the flexibility to continue their commitments to family and volunteer activities, and reward them for performance rather than narrowly specifying how they achieve that performance. I've seen that college students carefully research potential employers to see whether there's a match with their personal value systems.

5. What types of mobile technologies do you see impacting how organizations communicate and train the workforce?

Currently, few organizations are leveraging mobile devices, such as "smartphones" and mobile audio devices, such as MP3 players and iPods. However, employees themselves are buying and making use of these devices, so this represents a huge opportunity for organizations to leverage the technologies that are already in place. Some organizations are creating podcasts to enhance training classes and to provide updated corporate communication messages. There are some remarkable implementations of wearable computers in factory production and maintenance environments, such as telephone line repair and equipment troubleshooting and installation. We've only seen the "tip of the iceberg."

6. How does Gayeski Analytics use new media for training in organization performance?

Throughout my professional career, I've been involved in prototyping new media with my clients. Currently, I'm using new media in several of my consulting engagements, including online groupware and wikis for strategic planning for a college and for the US Centers for Medicare and Medicaid, "virtual office" software for the development and implementation of a course on virtual teams, and using mobile phones for rapid analysis and deployment of training in a number of my upcoming workshops. Personally, I use the new iPhone to organize my schedule and keep in touch with both my clients and my colleagues at Ithaca College while I'm on the road.

7. Has the ability to push information electronically assisted in communication? Or do organizations create a glut of information that backlashes against the intent to inform?

That's an important question. For the past 15 years I've been involved in researching and developing solutions for information overload, which is demonstrably more of a performance inhibitor than a lack of information or training. Much of my consulting involves doing performance analyses to see how people seek and use information at work, and identifying the barriers to efficient and effective performance. I think we're finally seeing the shift in corporate communication and training to trying to Reduce rather than Produce information. Many organizations are trying hard to limit the time that people need to spend in meetings and reading e-mails. But a more challenging and important initiative is to learn how to design, codify, update, and create interfaces for information so that users can easily get to relevant and accurate information that they need to do their jobs. Much of my work centers around prototyping such interfaces.

8. Your research agenda seems to be assessing and managing communication and learning systems as

intangible assets. Why do you refer to them as intangible assets, and how do you go about assessing them?

It's clear that the value of most organizations lies not in their tangible assets, such as buildings and machinery or even their bank balance—but in the elements that drive future value, such as the knowledge and motivation and loyalty of their employees, their culture, reputation and brand, and their inherent "rules and tools" that allow them to learn from customers, colleagues, and employees. These important elements are intangible in that the organization does not "own" them, and there is no way to put a specific dollar value on them. However, we can assess the extent to which organizations intentionally nurture these intangible assets, and we can look at the infrastructure that supports this.

When I am engaged by clients to assess their intangible learning and communication infrastructure, I look at things like policies or "rules" (written or informal) that support collaboration, information sharing, learning, and transparency of information. I also examine the technologies or "tools" that make it easy and efficient to scan the environment and to move quickly based on new information and skill-building. Finally, I assess the culture and reputation of the organization in terms of its products and brands as well as its systems for internal communication and work environment creation.

The accounting profession is struggling to create better ways to identify these intangible assets and put them "on the books." Currently most of these factors are lumped into a general category called "goodwill"—and that accounts for the difference between the actual "price" of a company and its tangible value on the books. For instance, a company could have $10 million in tangible assets, but a buyer would be willing to pay $35 million for the company because of the strength of its brand, its customer and employee loyalty, and its systems that support rapid innovation. Interestingly, it's the professions of training, human resources, and organizational communication that manage and build these intangible assets, so never before have we had such a terrific opportunity to create value.

9. This question could take a small book, but briefly could you discuss Generational issues in the workplace? I (MS) often find myself stuck between a rock and a hard place—I am helping older colleagues with very simple tasks, yet have to rely on younger colleagues to help with more complex tasks. This seems to be a manager's nightmare, yet we have pilgrims and novices and experts mixed into a quagmire, if you will, of technological skills. Is this the wave of the future? Will we always be dealing with this dilemma?

We've always had a mix of generations in the workplace, and the inherent clash of new ideas versus the wisdom of experience. However, I'm seeing more acknowledgment of this quagmire, and perhaps more extreme examples of differences in skills and conceptual schemes for looking at the world and navigating work.

For example, one of my clients is a casino and one of the line managers is supervising employees who literally range from age 16 to age 82. Because of the rapid changes in technology, many older people feel left behind—not merely in knowing how to work hardware and software—but in understanding the vocabulary and the huge shift in navigating and producing information.

For another example, younger people today, when faced with a question, will almost simultaneously call peers on their cellphones, put a question out on their "buddy list" in instant messaging, pull up Google and do a search, and perhaps also search traditional sources, such as articles or books or even company manuals. Because of the number and diversity of information sources, younger people may get richer and more up-to-date information, but they will also need more help in making sense of it and applying it correctly in their work environment.

The skills of supervisors will change dramatically. It's now almost inconsequential when you get to work and how many hours you put in, and it may not even be important to follow exact procedures. The important output is effective performance, so we need to measure output not input. However, supervisors will find themselves needing to build and manage virtual teams and having to spend more time coaching and providing positive feedback to younger workers who have grown to rely on a lot of support from elders and parents.

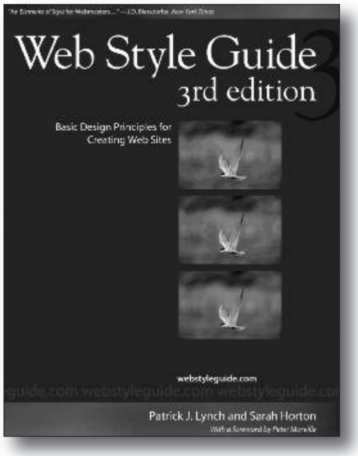
10. Briefly, tell us about your book "Learning Unplugged" and why it is important.

I wrote this book back in the late 90s when I could see that mobile technologies such as digital audio devices and smart cellphones had the capability of providing a means of not only accessing but also generating multimedia information quickly in an anytime/anywhere environment. The specific technologies covered in the book are not as important as the principles behind how one designs and manages the kinds of basic capabilities that mobile technologies support: audio, text, photos, video, and conversation. The lines between work and play and between seeking and producing information will blur—and these mobile devices are becoming almost a ubiquitous 'prosthesis' for people in their everyday lives. It seems only reasonable for professionals in learning and communication to leverage these technologies and new skills.

11. What is your latest book and why is it important?

My latest book, *Managing the Communication Function*, is published by the International Society for Business Communicators. Like the training function, the corporate communication function is undergoing rapid change, from being producers of information to being in charge of the infrastructure or "communication highway" upon which everybody in an organization is a *driver*. It's apparent that communicators don't control information anymore—employees and customers and activists can produce their own blogs, post their own videos on YouTube, and create their own communities through social networking and instant messenger buddy lists. What's important now is for professional communicators to understand and carefully design the systems through which stakeholders communicate—and to stay on top of the stream of information that impacts their organization. □

Book Reviews



Weaving the Tangled Web

Book Review: Patrick J. Lynch & Sarah Horton. ***Web Style Guide****, 3rd Edition. Yale University Press; 338 pages (with 185 color images); 2009; $30.*

Reviewed by Greg Kearsley

If Forrest Gump had commented on Web design, he probably would have said it was like peeling an onion, with each layer revealing something different. This book lays out the Web onion, layer by layer, and without the tears.

This is not a new work. In fact, the Web style guide has been available online since the early days of the Web (1993), and it has been used extensively as a reference and source for teaching over the years. However, this new print edition covers a lot more ground than past versions and what is currently available on the Website (although hopefully its contents will eventually show up online too).

Let me take you on a tour of the book starting at the core chapter: Typography. No matter what Web tool or application you are using (even e-mail), you almost always have control over the typography, which includes font size, typeface, line spacing, text color, emphasis, etc. These are the basic factors that affect legibility and aesthetics (i.e., the "look and feel") of a Web page. On the other hand, the authors point out that "The most distinctive characteristic of Web typography is its variability. Web pages are built on the fly each time they are loaded into a Web browser. Each line of text, each headline, and each unique font and style are re-created by a complex interaction of the Web browser, the Web server, and the operating system of the reader's computer." (p. 206)

To address these complex interactions, the book goes into considerable detail on the use of Cascading Style Sheets (CSS), a feature of HTML that allows you to control almost all Web elements at a global level. For example, you can use CSS to specify that all headers using the <h3> tag will be in Arial Bold without having to repeat that specification in every <h3> tag. And if you change the CSS specification, all instances in the document will be changed instantly (just like in a word processing style sheet). This is particularly important when it comes to dynamically reconfiguring a Web page for accessibility or smaller display considerations.

The next layer is page design, which is mostly concerned with the layout of text and graphics on the screen. As the authors explain: "The spatial organization of graphics and text on the Web page can engage users with graphic impact, direct their attention, prioritize the information they see, and make their interactions with our Website more enjoyable and efficient." (p. 171) The chapter reviews the basic principles of visual design including white space, contrast, consistency, and Gestalt psychology—plus mundane matters such as pagination and headers/footers. Given that a Web page can be displayed on a wide variety of screens (including cell phones), can be modified significantly by a user, and may be printed out, there are many things to take into account at this stage of design.

There is a whole chapter devoted to graphics that does a good job of discussing the pros/cons of different formats, compression, color, and the factors that affect resolution. This is very important information for all Web designers to understand because graphics can make or break a Website—both from an aesthetics and functional perspective. If graphic formats are not well chosen, they negatively impact the display performance of a Website and cause user frustration (which quickly translates into user migration).

Beyond the page layout is the design of the interface: "Users of Web documents don't just look at information, they interact with it in novel ways that have no precedents in paper document design; therefore, Web designers must be versed in the art and science of interface design." (p. 95) A key aspect of interface design is the creation of navigation options that allow users to easily find their way around the site, without getting lost in hyperspace. This

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The book reviews in this issue are the first in a new series to appear in most issues of the magazine. Authors/publishers of new books on aspects of educational technology may send books to be considered for review to ***Educational Technology****, 700 Palisade Avenue, Englewood Cliffs, NJ 07632–0564. For electronic books that appear on the Web only, without printed versions, send e-mail announcements of publications to the magazine at* ***edtecpubs@aol.com*** *. If a book appears in both print and electronic versions, it is the printed book that will be reviewed in these pages.*

is one aspect of Web design that has seen considerable standardization over the past decade with the use of pull-down tabs and navigation panels, breadcrumb trails showing your current path, site maps, and the proverbial search option to find things quickly without having to browse through the entire site. Indeed, search engine optimization is discussed at length in a chapter devoted to developing a good site structure.

Another aspect of interface design is ensuring usability, and in today's world, this equates to universal accessibility, i.e., Websites that can be accessed by everybody, without regard to any physical or cognitive restrictions. This means allowing for multiple methods of control, ability to enlarge screens, captions for graphics and transcripts for audio/video, and much careful thought in the composition of pages. Fittingly, the same chapter that discusses universal accessibility also covers techniques for user research. A fundamental law of good Web design is "know thy user."

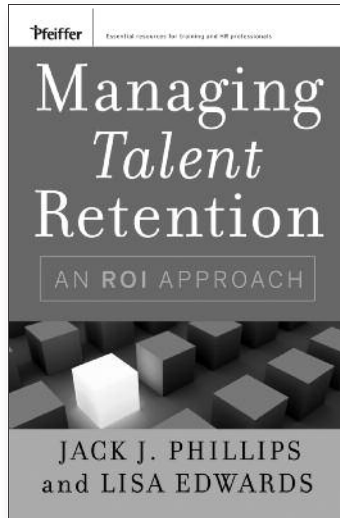
Given that this is a style guide, it's not too surprising to find a chapter devoted to editorial style. The interesting thing is that ten years ago, trying to define style guidelines for the Web would have been relatively fruitless given the chaotic state of affairs in the Web world. But now as we approach the 20th anniversary of the Web, there are consistent patterns to follow, such as how links are designated, where to locate the logo, search field or control options, how to design input fields, etc. Some of these conventions derive from the print world and others from operating system interfaces, but there are rules to follow now when it comes to Web design.

The newest additions to the third edition are chapters on information architecture and the Web development process. The former is concerned with the overall conceptual model associated with a site (i.e., how to organize the information to achieve its goals) and the latter addresses the steps in planning and developing a Website. These chapters come at the beginning of the book because they provide the big picture of what's involved in creating a Website. Of course, most people today don't actually design Websites, since they use application programs like blogs, wikis, media sharing and social networking tools, or learning management systems, which already come with well-defined interfaces.

The book is so full of useful information and guidance that it's hard to find fault with any aspect of it. But readers looking for help with the design of multimedia for the Web will probably find the one chapter on this topic a little sparse. The considerations discussed are solid, but this is such an immense subject that it is unrealistic to expect detailed coverage of how to create good Flash animations or the ins/outs of producing digital video. Maybe in the 4th edition, with an extra 100 pages.

There are many books available on different aspects of Web design (and the Reference section of this book provides an excellent summary), but few cover so much in such a concise and well-written fashion. In so far as the Web represents a frontier of human knowledge, Web design is like an adventure to an unknown and wild land. Take this book along with you as a guide. □

Book Reviews



The ROI of Talent Management

Book Review:
Jack J. Phillips & Lisa Edwards. ***Managing Talent Retention: An ROI Approach****.* *Pfeiffer; 432 pages; 2009; $45.*

Reviewed by Dean R. Spitzer

Many readers of this magazine are familiar with Jack Phillips and his numerous books and articles promoting the ROI approach to evaluating learning. We know of Phillips as the one who added a fifth level *(return on investment)* to Donald Kirkpatrick's famous four levels of learning evaluation (the other levels being *reaction, learning, application,* and *business results*). In this book (and in others on the subject), he has modified this slightly to *reaction, learning, application and implementation, business impact, return on investment,* and added yet another level *(intangible benefits)*.

The basic belief held by Phillips is that computing the ROI of an intervention (monetary value of the business impact achieved divided by the cost of the intervention) represents a substantially different level from the financial business impact (or results) themselves. Others, like me, disagree and argue that the ratio of business impact (in financial terms) to costs is really just an arithmetic manipulation of the financial business impact.

So, what does this have to do with managing talent? The answer is that this book is really two books—or at least two parts—in one. Part of the book is about talent/retention management and the other is about applying ROI to talent retention. My guess is that Lisa Edwards, the talent management expert, took the lead in the talent

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retention part, while Jack Phillips took the lead in the ROI part.

If you are looking for a book on talent retention, this is a pretty good, basic volume. There is some very good information on talent management in this book, but it reads like (and is formatted like) a textbook. I would describe it as a "primer" on the subject. If you are an experienced HR professional, you probably won't learn very much, although it might be a good refresher. However, if you want to learn the foundational concepts of talent retention, then this book is probably right down your alley. It is the kind of information that would be covered in an entry-level course on the subject. For example, there are blocks of information on the importance of talent retention, how to measure talent retention, the basics of why people leave jobs, how to create a more positive and motivating work environment, the importance of equitable pay and compensation, diagnosing reasons for turnover, interventions to improve talent retention (and reduce turnover), and how to match interventions with needs.

What differentiates this book, however, from others on the subject of talent retention is the focus on ROI. The basic rationale of the book is expressed in the following passage: "Successful talent acquisition and management is expensive" (p. 7). Therefore, the authors reason that it is important to be able to forecast and demonstrate the financial return on that expense (investment).

The book begins with an explanation of the importance of talent management and why talent retention is so important. Then the ROI approach to managing talent retention is introduced, followed by chapters on measuring turnover and departure data, and the cost of talent departure. Then there are chapters on diagnosing the causes of talent departure. Next, there are a series of chapters on best practices of talent management (recruiting, work environment, pay and performance management, and motivation), following by a chapter on how to match the interventions discussed to retention issues. The final chapters of the main text cover return on ROI (forecasting ROI, calculating ROI, and how to use the ROI data). In the Appendix, there are two case studies presented.

The chapters I found most helpful were "Develop Fully Loaded Costs of Talent Departure," which provides an excellent guide to calculating all the costs of turnover, and "Calculate the ROI of Retention Solutions," which provides the basics of ROI calculation. The most disappointing chapter was "Diagnose Causes of Talent Departure," which provided explanations of many problem-solving tools (such as surveys and questionnaires, interviews and focus groups, a long discussion of the Nominal Group Technique, brainstorming, cause-and effect diagrams, and many more), but I found the discussion to be quite generic. To give you a taste of the kind of information contained in the chapter, the advice for running focus groups was: ensure that management supports focus groups; plan topics, questions, and strategy carefully; keep the group size small; ensure that there is a representative sample; and insist on facilitators with appropriate experience.

Clearly, this book is about ROI as much as it is about talent retention. And, of coure, Jack Phillips is the principal proponent of its use. The eight-step ROI Approach discussed in this book can apply to any investment. First, measure the existing situation (turnover/retention in this case). Second, identify all of the costs of negative results (turnover/talent departure). Third, diagnose the cause of the problem (turnover/talent departure). Fourth, explore the range of options (to reduce turnover/talent departure). Fifth, match solutions to needs. Sixth, forecast the ROI of the solution. Seventh, calculate the actual ROI of the solution(s) selected. Eighth, make adjustments and continue. As you can see, this is a variation on the "systems approach," which has been a frequent subject of articles in this magazine over the years.

Readers should be aware that, while ROI can be a useful tool, like any tool, it can be misused. In today's highly competitive business (and government) environment, ROI analysis does seem to be the right thing to do and it talks the language of business (finances). However, it can create unrealistic expectations when used to justify a particular approach or reinforce a short-term payoff mentality. It is often based on questionable assumptions and can send the wrong message—that a particular intervention is the sole cause of a desired effect. One of the most dangerous abuses of ROI is its use to justify investments. You can use *assumptions* to inflate the value of virtually anything. One example I use in explaining this is a used car dealer who says to a prospective customer: "You might think that this car is worth $5,000, but just think of its value in terms of getting you to work each day…If you don't buy this car, it could cost you hundreds of thousands of dollars!" So, what is the *real ROI* of the vehicle or the retention solution? We can inflate the value of anything. It might get us more resources in the short-term, but what will it do for *real* business value or our credibility? The authors do point out the potential danger of ROI forecasting in the following caveat: "The retention coordinator communicated these projected values to the CEO, but cautioned that the data were very subjective, although they had been adjusted downward" (p. 271).

As long as you approach ROI, and this book, with your eyes wide open, you should find it valuable both from a talent-retention and an ROI perspective. So, if you are trying to decide whether to invest in this book, hopefully this review has helped you to make a smart investment decision. □

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*Send your Reader Comments to us at **edtecpubs@aol.com** . In general, your message should be up to 750 words in length, though longer contributions will be considered, depending on the topic. Join in the ongoing conversation in the pages of this magazine.*

Reader Comments

Schools with Wireless Licenses Can Support Wi-Max Systems

John W. Kuzin

Wiley Rein LLP

Educational institutions holding 2.5 GHz wireless spectrum licenses may be sitting on a small pot of gold. Educators may be unaware that spectrum leases they may have signed in the 1990s may be expiring soon. And, when they do expire, educators can enter into a new lease arrangement with increased payments.

The Federal Communications Commission ("FCC") has reinvigorated educational licensees' ability to lease their 2.5 GHz spectrum licenses to commercial wireless broadband service providers via three decisions released over the past several years. The new Educational Broadband Service ("EBS") is intended to support state-of-the-art wireless broadband, or Wi-Max, services. The EBS is the new name for the Instructional Television Fixed Service ("ITFS"), which had supported broadcast video services since the 1960s. While this spectrum was used to support wireless cable systems and first-generation wireless Internet systems, they were less successful than the FCC had hoped.

FCC Leasing Opportunities

Commercial wireless service providers are taking advantage of the FCC's new frequency band plan that makes the spectrum more amenable to Wi-Max deployments and gives the providers greater usage flexibility. Commercial providers have been moving swiftly to secure the rights to use EBS spectrum in many regions of the country. Providers such as the new Clearwire, which recently merged its 2.5 GHz spectrum operations with Sprint Nextel, and Xanadoo Communications, are offering EBS licensees increased monthly rents and up-front payments in exchange for leasing their spectrum rights for a 30-year term.

The "Form Lease"

Once a commercial provider identifies a viable spectrum leasing opportunity, it typically presents a "form lease" agreement to the EBS licensee that, not surprisingly, contains provisions that favor the provider. Some of these provisions are discussed below.

The ROFR Provision. A Right-Of-First-Refusal ("ROFR") provision commonly appears in spectrum leases. The ROFR gives the provider the right to match any offer to purchase or lease the spectrum at the end of the lease term should the EBS licensee receive a "bona fide" offer from a third party to purchase or lease the license. Licensees need to understand how a ROFR provision can impact their ability to secure third party offers to lease and sell their spectrum rights both during and after the termination of the contract.

The FCC's Substantial Service and Educational Use Requirements. EBS licensees must comply with the FCC's substantial service and educational use requirements in order to maintain their licenses. Substantial service requirements ensure that the spectrum is used to provide services in the license's coverage area, and educational use requirements ensure that licensees are using the spectrum to further their educational mission. Service providers often attempt to place the burden for complying with these requirements upon the licensee, but the service providers often hold the key to ensuring compliance with both requirements.

Undeniably, commercial service providers are leasing the licensee's EBS spectrum to build a wireless system. Once that system is built and operational, it can be used to provide substantial service within the license's service area and allow the licensee to use the provider's services to comply with the educational use requirements. Therefore, lease provisions that require the provider to build a system in a timely manner are critically important to the EBS licensee's ability to maintain the license.

Spectrum Value

The amount that providers will pay to lease EBS spectrum depends upon the location of and population coverage within the license's service area. Like typical real estate transactions, EBS spectrum located in and around highly populated metropolitan areas will court much higher rents and up-front payments than will spectrum in less-populated rural areas. Other factors that are important to determining value are the number of other 2.5 GHz licenses available for lease and wireless broadband competition in the service area.

History of the 2.5 GHz ITFS/EBS Band and the Transition

The FCC established the ITFS in 1963 to provide educational and cultural programming to students in U.S. accredited educational institutions. In the early 1970s, the FCC created an exclusive allocation for ITFS consisting of 28 television channels in the 2.5 GHz band. About the same time, the FCC also created the Multipoint Distribution Service ("MDS") in the upper portion of the 2.5 GHz band, which was intended to support wireless cable systems. In 1998, the FCC adopted technical rules giving MDS and ITFS licensees the ability to deliver two-way Internet access services via cellularized systems.

These early two-way systems experienced interference from high-power broadcast television operations, which led

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the FCC to restructure the band. In its band restructuring order, which was issued in July 2004, the FCC acknowledged that the regulatory history of the 2.5 GHz band has been marked by changing policy goals that have suppressed investment and innovation in the band. Given the frenzy of leasing activity in the EBS band in response to the FCC's new rules enacted in 2004, 2006, and 2008, the latest actions appear to be a success. Indeed, transition to the new band plan has been proceeding rapidly, with well over half of the transition areas already completed. □

Educational Technology in Bad Financial Times: *Can It Survive and Even Thrive?*

Roger Kaufman

There is an old burlesque routine (please don't ask how I know) of a drunk searching for his keys near a lamppost at night. A helpful stranger asks: "Is this where you lost your keys?" Answer: "No, but the light is better here." And so it is with our field. We look primarily to "where the light is better."

Our lamplit site has a focus on individual and small-group performance. We have a long tradition of doing so and still wonder why our contributions are not more valued and rewarded. The research literature on human and group performance improvement is long, distinguished, and growing. We know more about performance improvement than ever before. We even know more than is routinely applied in programs, projects, and activities. We write about concepts, tools, methods, and processes for individual performance improvement. We go to conferences and conventions and present and listen to speeches and discussions about individual and small-group performance improvement. We have even developed return-on-investment models and tools for estimating how much money we save from new individual performance-improvement efforts. The light is very good here.

When a few "outliers" try to talk about linking these efforts and tools to outside-the-organization returns, the responses are, at best, underwhelming and get quietly labeled as not real-world, unrealistic, utopian, politically impossible.…

Now, we are in bad financial times. No matter who or what we choose to blame (and that seems to be a national sport: "fix the blame, not the problem") the old ways of viewing and attempting to resolve problems won't work to make us successful and prove our worth, even if doing so is the conventional wisdom. The light is good and the times are bad, as we lose jobs and suffer lower organizational status.

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Yet what do we do as we wring our hands—if they are not fully extended for receiving charity (oops, bailouts)? We continue to focus on individual performance improvement. Just look at the existing models for our field. Even the best still are reactive, and only a few of those used today look to the external environment for guidance on how to let the organization do better, without first looking to see if the organization can make the society better even as it does its own work. If a model does look at the external environment, it does so in a reactive manner and not proactively. Good light, poor results.

As we are internally focused, our return-on-investment models speak to conventional indicators. We look to see how much money a well-designed performance intervention saved. We tip our hats to shareholder value and use partial if not archaic performance value indicators. We continue to do this and don't look to the fact that the paradigm is shifting from individual performance results to also "value-added" for both our organizations and society.

After all, the light is better at this current location. And the terrain is familiar and comfortable. But will it help us work through bad financial times, where more and more professionals are being asked to show how we help our organizations to survive and thrive? Self-promotion will not work. We have to expand our view and thus our influence. We have to shine light on where our keys-to-success lie.

How can any rational person not realize that the intense focus on individual and organizational performance improvement has mis-served public and private organizations. For instance, what real value would have come from improving the operational performance of individual employees at Fannie Mae, Freddie Mac, Treasury, Congress, the White House, CitiGroup, Madoff Investments, Chrysler, General Motors, United Auto Workers, the SEC, World Bank, the UN, District of Columbia Schools, Chicago Schools…well, you get the idea.

If an organization's mission is misguided or incomplete, no amount of local individual performance improvement will set things right. Does anyone really believe that our organizations have useful mission objectives? How many actually include adding value to our shared society? Talk about getting very good at rearranging the deckchairs on the Titanic!

Increasingly, we are being asked not only to show how we add value to the conventional "bottom line" but also on how we are adding measurable value to our clients—all of them, including society as a whole.

Don't want to do it? Don't think we can? Then keep redoubling your efforts after losing sight of the basic bottom line—the societal bottom line. There are now tools for defining shared societal value-added and then being able to measure and validate it.

When we change our paradigm from just individual performance improvement (as important as that is) to also adding societal value, and being able to provide it, we will be more likely to not only survive during financial bad times, but also thrive. We will do so by being able to provide data on how we really "earn our keep"—how we add organizational and societal value—something that others now avoid. Or assume.

Your choice; continue to work under the usual lamplight or shine a beacon on the future to help to create it. □

Learning Trails

Traversing the European Ed Tech Scene

Kevin Walker

Business in Barcelona, and Beyond

After last column's foray into postmodernism, this time we visit a top international business school which is putting some of the leading e-learning research into practice, and get some insight into pan-European policy and business practices as well.

I walked up a hill just off of Barcelona's bisecting Avinguda Diagonal to meet Margarida Romero at the campus of ESADE. She works in the E-learning & Learning Innovation Unit, integrating e-learning technologies into the school and also helping the organization keep up with international initiatives, such as the drive to create a common European Higher Education Area by 2010. After climbing the hill, I followed directions down a stairwell.

"This is a 'think tank' in the real sense of the term," Margarida remarks, "because we are in a little bunker under the main floor. But near here also is the Dean's office, so we have a lot of informal interactions; we can perceive the movements of the organization. It's so important, because we are working with competencies, and these have values behind them, so we need to know the strategic vision behind the institution in order to make the learning innovations bi-directional—not just making things, but putting them in a strategic 'vector.' It's learning innovation as organizational change management."

Scripting Business

Like other business schools, ESADE has Bachelors and MBA programs, and has links with other schools, including Georgetown in the US. These provide students with valuable international perspectives and networking opportunities.

"We integrate e-learning at all levels. We need to work in a very different way because for undergraduates the classes are big—up to 100 students—so we're integrating technologies to support collaborative activities which one professor can manage. Because the organization is not changing at the same speed as the technology, we cannot open up all the interaction possibilities. So we are always scripting and designing the interactions, in order that the timing for the professor is very specific."

This draws from research I have reported on previously, for example by Pierre Dillenbourg in Switzerland and Armin Weinberger in Germany, on the precise regulation of student activities through scripts intended to prompt interactions productive for learning. ESADE provides a case study for how this works in practice.

"What we do is like in the cinema," explains Romero. "We are scripting each phase in order to attain each learning objective. An activity aimed at conceptual change in the students, for example introducing students to fiscal accountability, is hard—especially to learn at first. The conceptual habit is hard to learn.

"An activity can act in a collaborative way, making the first phases individual, by making them model what accountability is, in terms of a business. In each model, there may be correct ideas or misconceptions. This is very valuable because each individual has done the work, has tried his own concepts of what accountability is.

"Then, they negotiate the models together, in a group. But there is a bit of socio-cognitive conflict. Because they don't know the subject, the domain, they have very different models. But they need to negotiate a common model. When you're negotiating, it could be democratic or not so democratic, and you can agree wtih different models to different degrees. Each student can measure the group model against his own, with a percentage.

"Then each negotiates the evaluation of this assignment—if you think the group is wrong and prefer your model, you can say, 'I want only 10 percent of the group model and 90 percent from mine.'

"Then, the professor starts the course knowing all the students' models, and what has been the conceptual change, in a collaborative way. When the professor starts to draw his own model, as a student you are not in a passive mode—you have done your own model. And you can see the difference."

As well as stimulating constructive and collaborative learning, this approach also has very practical aims—maximizing professors' limited time.

"The way we work with professors is to understand the way they work—their 'Zone of Proximal Development' in the learning methodologies," says Romero. "Then we propose very specific activities, which must be very scripted to make sure they will not be a risk—personalized to the professor. We have them at the implementation level, not just theoretical level. And in a concrete way, we can help them to create a learning space to create certain kinds of interaction."

Tech Support

Technology supports this approach in various ways.

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"There are modeling tools that can be used. We use concept maps—for example, for the accountability models. To submit to the professor, students can choose their own software; they can scan it, or take a photo—this is very easy because they all have cameras.

"For me one of the barriers of the technology is not participants, because students are asking for these kinds of interactions—they want all the course materials online, they want to participate directly with the professors. But when a professor has been teaching for years, thinking it was perfect, then you say to him, 'We could improve it with technology,' he says 'Why?' So the minimum we ask from professors is a syllabus. Even then it can be hard to get, because they make changes as they go."'

While professors are having to adjust to new technologies, so too are students, and European reforms—known as the Bologna process—are intended to take this into account.

"It's very important," says Romero, "because the way a course is calculated is no longer based on teaching time—it's the learning time, because students do so much outside the classroom. The Bologna process is very interesting in this way because its aim is to develop autonomous work and lifelong learning skills. So we cannot any more count only teaching hours because that's a teaching model—a teacher-monitoring model. Now we have to estimate each activity: how many hours in class, how much autonomous work by the students; in the end this must be a percentage higher than the teaching hours."

Outside of School

Romero is perfectly qualified for her work, currently writing up her doctoral thesis. Fittingly, this is a European Ph.D., conducted between the Universitat Autònoma de Barcelona and the University of Toulouse-le-Mirail in France.

"It's quite new," she says. "Quite a mess in an administrative way, but it's very interesting because you have a double title of Ph.D. in each country. I have dual nationality—Spanish and French, and I wanted to have a French Ph.D and a Spanish one.

"It's interesting at the first stage because my background is Computer Science, but the Ph.D. is in Psychology. And the way psychology is approached in France and Spain is of course completely different. In Toulouse I work with a team studying metacognition and self regulation—a very psychological approach. And the way my Spanish research group approaches psychology is more grounded theory, a more qualitative approach.

"I was previously in the computer science lab of the University of Le Mans, with Pierre Tchounikine. And he told me, 'Well, you're too much interested in the person in front of the computer and not so much in the computer itself!' And I do care more about that than the professor or the software. So he said, 'The best advice I can give you is to move to psychology for your PhD.' So I focused on metacognition in interactive learning environments from the psychologists' point of view.

"One of the most interesting parts of my Ph.D. is an international virtual campus, oriented toward project-based learning. And the campus has a lot of different nationalities—a lot of African students; it's a French-speaking campus, so all the former French colonies. Also Central America, and islands such as Reunion.

"The problem of course is doing collaborative work—you need to meet sometimes online to do some of the work synchronously. But sometimes you have seven hours difference, and students on a virtual campus have work and families. Not only that, but in parts of Africa not all the students have their own computers. So they may have to ride a bike 10 kilometers to a public access point, which may only be open from 9 A.M. to 1 P.M. The time restrictions are important for collaborating.

"So my research is looking at how they are dealing with this restriction. I try to understand some of the strategies they have to deal with this limitation. We could provide tools to do the work asynchronously, or coordinate subgroups. But these are not natural for people. The first step is making them aware of the time issues. A group might lose diversity, but is that worse than losing the collaboration?"

Back to Business

"A trend in the European Commission is that it's trying to harmonize some slots of time, in order to make business possible. In Spain in the Summer, there may be nobody around in the afternoon. But this does not always suit partners in some other countries."

Romero's research is clearly of benefit not just to university students, but the corporate training sector as well—a sector which has become quite big here in Europe, stimulated by EU and national funding.

"In France, for example," Romero explains, "there is a policy: Lifelong learning for every person in a company. It's fantastic. The company needs to provide lifelong learning to the workers at least ten hours per year per worker.

"This time is not extra time, but within company hours. And if you have a big company and you need to provide all these hours, then e-learning and blended learning solutions are very useful.

"You can, for example, do a course that has a very small time slot in each day. One company put a self-learning system, an autonomous computer, beside the coffee machine, with three-minute use cases to solve.

"It's because there's a policy for lifelong learning. And when a company is investing in lifelong learning, whether traditional, blended or e-learning, they are avoiding paying taxes. Fantastic. And thus there are a lot of e-learning companies making this kind of content."

Romero also counts herself part of this sector, with her own consultancy, *Ouak.net*. Thus, she sits in the very center of policy, academia, and industry, learning cutting-edge research and putting it into practice in business, on a European and global scale. □

Topics for Debate

Alexander J. Romiszowski

Observations on Social Networking in Education

Prologue. Sometime in the early 1990s, when I was still full-time at Syracuse University, I was invited to teach a workshop at Indiana University. I stayed at the house of my long-term colleague and dear friend, Michael Molenda, then a full-time professor at IU. I recall more than one occasion when an interesting evening conversation was "put on hold" because it was time to catch the David Letterman late-late show. I remember marveling that a person who seemed to love nothing more than an interactive social conversation should be so "hooked" on a program which, for me, was a prime motive for switching to another channel! I wondered if this was a cultural-indoctrination phenomenon—that I, born and bred in Europe, had been raised on a different diet of humor and satire and thus could not perceive or relate to the attractions that Mike saw in the show.

I am now living back in Brazil with my grown-up, beyond teenage, children, one who was born in the USA and lived there till age eight and the other raised in Syracuse from age three to thirteen. Both, now in Rio for over a dozen years, are as Brazilian as any Brazilian, especially as regards their social life. But they are both regular and avid viewers of the David Letterman show on cable TV. This is particularly interesting, as in Brazil we have a near-carbon copy—a late-night talk show with the same program structure, hosted by an ex-TV-comic-showman called Jo Soares. I find Jo Soares more interesting and entertaining than the David Letterman show, but the "kids" do not relate to Jo at all. This seems to support the above-mentioned hypothesis.

But there may be another reason why many US-born-and-bred folks in my age group are hooked on Letterman—maybe they remember when, as a younger, stand-up comedian he appeared in comedy shows that "really were funny." I can relate to that argument, as I remember the comedy shows of Jo Soares on Brazilian TV in the late '70s and early '80s, which were much funnier than his current talk show, and I watched them regularly and avidly. So, maybe a part of the phenomenon is explained by force of habit.

Issue 1: Social Versus Professional Networking. The above prologue came to mind as I began to write this column because I compared the position I assume in this column toward social networking with the position that Jo Soares adopted in one of the most hilarious of his '70s TV comedy sketches. Jo's position was "flat on his back"—on a psychiatrist's couch. The psychiatrist asks, "What's your problem." Jo responds, "There's something very wrong. I have never been mugged. All my friends and acquaintances have been mugged, some several times, but nobody has ever mugged me. What's wrong with me? Why does nobody want to mug me?"

It takes the competence of a professional comic to turn that relatively simple basic idea into a hilarious sketch, unforgettable over a 30-year period. I do not plan to make anyone laugh when I borrow the idea, place myself on the psychiatrist's couch, and explain: "I have never read or posted a message, of any sort, to a social networking Website. What's wrong with me?"

I should explain that I see a great difference between groups of professionals who gather together to share information and give mutual support to each other in the pursuit of some well-defined (and preferably useful) goal, and groups of folks who choose to hang out in the same bars, clubs or malls, possibly with only some fuzzy goal of "togetherness," or maybe with quite well-defined personal goals related to "making it" (or "making out") in the group.

Moving to the online world, an example of the first category would be a community of practice. I actually do belong to such communities, focused on my educational-technology profession and also on my hobbies, such as classic motorcycles. It is the second group, exemplified by such sites as Facebook, Orkut, and so many others (a new one every day, it seems) that are the source of my "problem."

The problem is not that I have something against the basic concept of social networking, but that I cannot relate to the idea of substituting real-life networking at the local watering holes or jazz clubs, or on Rio's beaches, for virtual networking on the Web. The time spent reading and posting messages in Facebook seems to be lost that could have been spent chatting to (and chatting up) real people, real-time, face-to-face. This may of course be seen as just a personal preference: one man's pleasure is another man's poison; you can't please everyone all the time: so what!

However, it becomes somewhat of a public, and indeed a professional, problem when I am asked to incorporate such social networking in an educational program or

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agenda. "What is the purpose?" I ask. And, if there is a definable purpose that "makes sense" in terms of educational philosophies and values, then as an educational technologist I am bound to seek ways in which the defined purposes are transformed into measurable indicators, tracked, outcomes evaluated, and remedial actions taken if results do not match up to expectations. If I do not do these things, I am not only acting unprofessionally, but I may also be accused of misuse of public funds.

Issue 2: Should We Use Social Networking in Education? In order to get some quantitative idea of what is really happening in the educational arena, I did some research on the Web. I was particularly taken by one Website which, as may be deduced from its URL, is a Wiki set up so anyone can document the existence of any social network linked to education: *http://socialnetworksined.wikispaces.com/* .

I accessed this site on January 2, 2009 and counted a total of 291 education-focused "social networks." I have used quotation marks as the listing makes no distinction between what I have referred to as professional and social networks. It may have been useful if the sites in the list were classified in this way, but instead, they are classified in terms of the technological tools used to set up the site: Diigo-based (1); Elgg-based (3); Linked In based (1); Ning-based (251, further sub-classified into 22 subject-matter-focused and teaching-method-focused categories—that's something more useful); Non-Ning Based (29); Facebook-based (6).

I wondered how many of these networks are really active and useful. I did not spend the time necessary to find out by accessing them all, but I guess that many are not very active or useful from my experience in trying to learning a bit more about the different platforms, Elgg, Ning, and so forth. At the following URL, I found a discussion on the topic: *http://www.sitepoint.com/forums/showthread.php?t=550230* . This was initiated by a two-part message posted last May 24, from a consultant using the online nickname "Summer9," who was seeking information s/he needed in order to advise a client regarding the technical capabilities of these and other platforms.

The first three replies came almost a month later, on June 16, 21, and 23. They were short, terse, and I felt not very helpful to the original inquirer—that is, if s/he was still interested, as it seemed to me that the original question was very much time-critical. Then there was silence—until September 3, when someone nicknamed "Quaghead" posted a message which said: "Reviving this—Summer9—am curious what you ended up choosing and how you and your client liked it? Also interested to hear updated opinions about Dolphin vs. Ning." This generated a dozen or more reply messages by the end of September, again short and terse, mainly recounting "techie" problems or benefits of one or other platform. Unsurprisingly, "Summer9" was not one of the respondents.

I quote the above interchange not only because it is so typical of the *inconclusive searches* for information and mutual support that so often occur in communities on the net, but mainly because the example illustrates so clearly the need for professional design and management of professional networks, in ways that are quite different from the laissez faire and largely "user-driven" social networking models.

Issue 3: Social Network Analysis as a Research Tool. Having used the term "model" in the last sentence, I must distinguish between my use of this term in the sense of a model for planning, structuring, using, and managing an online network (just as when we talk of "ID models" in our professional field) and the scientific research connotation, which is illustrated in a paper to which I here give the full reference: Lee, J.-S., Cho, H., Gay, G., Davidson, B., & Ingraffea, A. (2003). Technology Acceptance and Social Networking in Distance Learning. *Educational Technology & Society, 6(2), 50–61 (http://www.ifets.info/journals/6_2/6. html*).

The authors define social networking as the social relations among a set of collaborating "actors" and use social network analysis to study the impact of collaboration on the formation of attitudes in online distance learning environments. They describe the changes of attitude toward use of a productivity tool called AIDE as a result of direct experience of using the tool and as a result of other colleagues' opinions and attitudes communicated through the social interchanges occurring among the students participating in the course. They showed that, initially, students' attitudes were determined by how useful AIDE was in fulfilling their intended tasks. However, over time, as group cohesiveness increased and exposure to social information increased, student attitudes were influenced by their peers and tended to become homogenous. The final attitudes were socially influenced.

Epilogue. I wind up this column with three observations, each springing from one of the issues addressed earlier. The first is that we are tending to use the term "social networking" too broadly and loosely. This is a common tendency with new terminology which becomes (too) popular. Everything which involves two or more people communicating could be described as social networking, but is it useful if we use our terminology that loosely? Let's have some scientific clarity in our terms!

My second observation is that networks of educators (and/or students) should be purposive and, as such, should be designed, developed, implemented, and managed according to the rules and methods that we tend to use elsewhere when dealing with purposive, complex, and probabilistic systems. Cybernetics—come back—all is forgiven!

My third observation is that there are social networking processes and effects in any group-interaction situation. The study of these is a legitimate and important scientific undertaking, the results of which may (indeed should) influence the design decisions of those who plan and implement networks for educational purposes. However, note the word "purposes." Let us not confuse ends and means! Let's remember what it means to be a technologist! □

New Issues, New Answers

Marc Prensky

Memo to President Obama

You dedicated one of your Inaugural Balls to showing off new educational technologies, which is a welcome signal from your Administration. But before any technology can really help our kids' education, we need to reform both *what* we teach and *how* we teach, in fundamental ways. The surest road to failure for our students would be to "fix" education so that it does the same work it did in the twentieth century, with some extra equipment, rather than change our education fundamentally for the twenty-first century.

We talk about how futile it is to throw money at an auto industry that is so far behind the time, or at a financial industry that is doing the fundamentally wrong things, without demanding radical reforms. Our educational system is an even worse case. Things have changed so much in society in the last 30 years that we have reached the point where our students are no longer the ones that our systems were designed for, and that our teachers were trained to teach. Just throwing money in the form of technology—as good as that technology is and will become—will not help. *Reform is needed for the technology to work.*

Take our current curriculum. It is, on all levels, from kindergarten through high school, hopelessly outdated for the twenty-first century, and ought to be completely rethought, adding many subjects that didn't exist in the past, and many future-oriented skills that are currently untaught. Since our curricula are not only full, but overloaded, in order to make room for such things we must drop others—many of which are near and dear to educators' hearts.

Ask yourself this: How can we make room in our teaching for the desperately needed skills of ethical behavior, critical thinking, decision making, problem solving, and judgment? Where do we fit our teaching of goal setting, planning, self-direction, and self-evaluation? Of communicating and interacting with individuals and groups using technology? Of communicating with our ever-more powerful machines? Of communicating with a world audience? Where should we put our teaching of creative thinking, designing, playing, and helping kids to find their own voice? Where do we teach our students to be proactive, to take prudent risks, to think long-term, laterally, and strategically?

Our concepts of "age-appropriateness" in education need to be completely re-examined, in ways that have, up till now, hardly been discussed. We need to recognize that our children and students are capable of using and understanding much more sophisticated tools than have ever been used in the past—tools that are sometimes beyond the ken of our educators.

Our kids who start school today will compete in the world more than a decade, and in some cases almost two decades, from now. Do we do them any favors by helping them compete better on the skills of yesterday? Twenty years from now, will today's kids be better off with a solid knowledge of the long-division algorithm (which "better teaching" today's curriculum might, conceivably, give them), or with a solid foundation in problem solving (which we really don't provide)? Will they be better off writing neat cursive handwriting or writing computer code? We may not have room for both.

Equally important is *how* we teach, and this brings us back to the technology. The primary mode of teaching in our country is still the lecture-explanation to the whole class by the teacher. With only a few exceptions, students today have rejected this approach completely. "My teachers just talk and talk and talk" say kids, over and over again from Maine to Idaho to California, Florida, and the Midwest. "It's not Attention Deficit—I'm just not listening" reads their classic t-shirt.

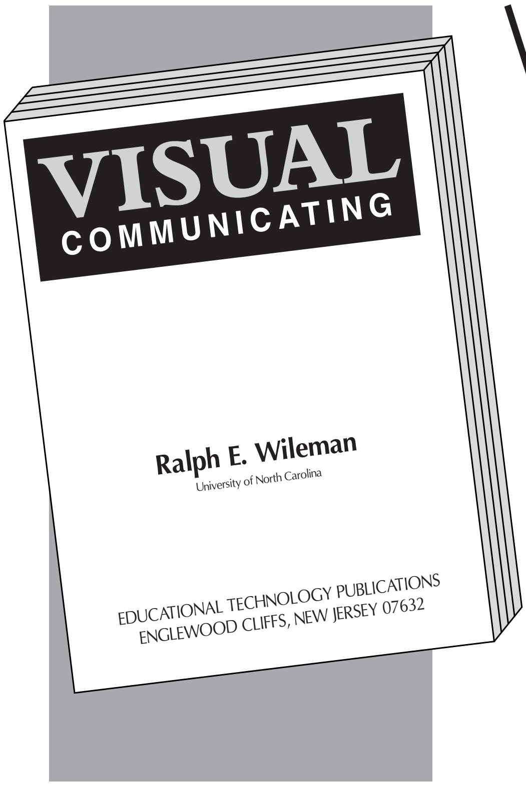
No amount of technology will help solve this problem. The most technology can offer to a lecturer is pictures and video, which is no improvement at all. In a lecture-based classroom, bored students with laptops use them to enter Facebook and to play games.

But a new pedagogical paradigm has arisen in the education world, starting mostly in charter schools and other pockets. Schools and teachers have begun to *let students learn on their own (and from each other) with their teachers' guidance*. Known alternatively as inquiry-based learning, problem-based learning, case-based learning, or learning by doing, it is Deweyism brought back to the life it should have had.

It is this pedagogy that technology really assists, and all our teachers should be moving to it as quickly as possible. While it involves giving up some traditional "control," the payback comes in student engagement and success. And when done well, learning becomes a true partnership between teachers and students. The students do what they do well, which is use technology to connect, to find information, and to create presentations in multiple media. Teachers do what they do best, which is to ask the right questions, provide context, control quality, and ensure rigor. Students and teachers learn from each other. Unfortunately, most of our teacher-training schools are totally unprepared for this pedagogy and are still preparing teachers for the ways of the nineteenth and twentieth centuries.

This is where your Administration can have the greatest effect on education. If you define a new curriculum oriented to the twenty-first century, and it encourages all teachers to move quickly to the "new" pedagogical paradigm, our kids will be better than the rest of the world—not just at answering test questions, but at creating, and at solving real problems on their own and with their peers. If all we get are better ways to do the same old stuff, even if test scores rise in the short term, then, in the long term, we all lose. □

***Marc Prensky** is an international speaker, writer, consultant, and game designer in critical areas of education and learning. Marc can be contacted at **marc@games2train.com** .*



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