

The Right Train



By Howard Strauss

1. New Technologies in Teaching and Learning

New technologies could change the nature of classroom instruction in colleges and universities, but they probably will not. If we constrain ourselves to changing the nature of instruction in classrooms where traditional courses are taught in traditional, degree-granting institutions, we will never change the nature of instruction very much. Instead, we should ask why we need classrooms: why have courses, why have an instructor, why have degrees, why have a college or university at all? Do we want the technology to help us do things the way we have always done them, or do we want it to enhance learning and understanding in whatever way turns out to be best? We will not get the most benefit from technology if we insist on applying it to the old talk-and-chalk paradigm. In fact, this is one important reason we have not seen a large return on investment in technology for classroom instruction.

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The image features a background of an aerial photograph showing a road and a forest. A prominent red horizontal line runs across the middle of the page, intersecting the title text.

at the Right Station

When some harried driver recently stopped me and frantically asked how to get to the Princeton train station, I could have just told her that it was only a few blocks away, and she'd have been there in a minute or two. But instead I asked her *why* she wanted to get there. "I've got to meet the train from New York," she said. New York trains do not stop at the Princeton train station. They stop at the Princeton Junction train station, a few miles away. I told the driver how to get to the Princeton Junction station, and she was quickly on her way. We do not want our faculty waiting at the wrong station for a train that will never arrive.

Implications

Distributed learning and virtual universities (or at least virtual classrooms) do have great potential to change things, but I use the words *classroom* and *univer-*

sity only as temporary proxies for what really needs to evolve. We don't need classrooms—large spaces where many students come together to listen to someone for some arbitrary amount of time. Doing the same thing online as a virtual classroom does not improve the model; it only takes advantage of the network and mobility. Technology can eliminate the need for classrooms, courses, degrees, and colleges/universities. Although this won't happen tomorrow, the seeds are growing in fertile ground fed largely by commercial institutions that have discovered, for the first time in history, that there is a great deal of money to be made from education. Colleges and universities may not think of Sony, Disney, Ford Motor Company, and the U.S. Army as their rivals today, but these organizations—and others like them—will be tough competitors

soon enough. For example, consider the following:

For more than a decade, professionals from around the world have come to Walt Disney World® Resort to seek best practices for benchmarking purposes and discover the “Disney approach” to current business and management issues. Learn about our unique approach to professional development by taking a peek at our campus—the Disney Institute—or by requesting more information or simply browsing through our different offerings for individuals and groups. We hope you’ll visit us soon, so we can add your name to our growing list of alumni who have discovered the business behind the magic!

thing else—if the device will work only for its owner and authorized friends? If we add biometrics to GPS, mobile systems, and specialized intelligent devices, we will have a sea of intelligent networked devices that know where they are and who they are with. What creative things we do with that capability will depend on the questions we ask.

Voice recognition will also play an important role in the near future. Already when I call a local department store, instead of having to go through a long hierarchy of menus that ask me to press “1” for this, “2” for that, and so forth, I’m now just asked to say what department I want. When I say “electronics,” the system is clever enough to ask me if I want “technology for the home” if there is no electronics department. Although today I

big payoff in higher education. In the sciences, raw computational power has allowed students to do things they could never have done before. Suppose a student wants to learn about parabolas. Before computers, the student would have painstakingly graphed a few parabolas and would have looked at a textbook and seen a few more. Today, a student can use a computer to vary the parameters for a parabola and can instantly see what changing a parameter does. The student adds or subtracts a constant and presto! The new plot is there. The student can put one plot over the other or next to another. A computer gives students the joy of discovering things on their own and the thrill of getting algebra intuition.

The network has also brought about some wonderful changes. The Princeton



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This is quoted from the Disney Institute Web site. Disney? Doing post-MBA training? An official at the Institute told me that the Harvard Business School was one of its main competitors but that many companies preferred Disney to Harvard! Disney gives no degrees or credit. It isn’t a university and doesn’t plan to be. But it offers education. And the Disney Institute is asking some of the right questions and getting great answers.

“Left-field” Technologies

One unexpected technology that will have a great impact in the short run is biometric authentication. At first it will just get rid of the nuisance of remembering and managing zillions of IDs and passwords and carrying a dozen identification cards, but ultimately, by making authentication and authorization really secure, it will allow for new applications. Internet voting, for example, could be better done with biometric authentication. Car theft could disappear if a car can “recognize” its owner. Why steal a laptop—or any-

must press an arcane series of keys on my university phone to tell our voice-mail system to play a vacation message while I’m out of the office, tomorrow I’ll just tell it, or better yet, it will check my electronic calendar and automatically schedule the vacation message for me.

Vision systems also have great potential. Think about how hearing and understanding speech enhances our abilities, and then consider how much more the gift of sight expands what we can do. Vision systems will have the same effect on computers, giving them an interface that will let them do real-world jobs such as driving cars, flying planes, checking out groceries, and reading body language.

Lastly, digital ink and digital paper, though further behind in development than some of these other technologies, will finally allow us to interact with all the information we are authorized to touch, anywhere and anytime.

2. Return on Investment

Some technology investments have had a

University language labs are gone. No one has to wait for a language tape. Students can listen to any “tape” at any time, even in the middle of the night, and at any place, even from home or on vacation in Sri Lanka. Soon our videos will be distributed as well. And in a few of our art classes where all of the slides have been digitized and been made Web-accessible (only to Princeton students), the whole nature of learning has changed. In the past, students would go to the slide collection room, sign out a tray of slides, and get the use of a slide viewer for a short period of time. A student would look at a slide, take a few notes, and look at another. Once done with a tray of slides, the student had to return to the end of the line, which got quite long close to exam time. Today, not only can students look at slides in their dorm rooms and at public clusters around campus, but there are no lines, every student can look at the same slide at the same time, and slides cannot be damaged or stolen. More amazing, students on their own have discovered that

they can display two or more slides on the screen together and compare them.

E-mail has also changed the way teaching is done, and so has the Web. Obviously, technology offers higher education much more than we have realized. There is nothing inherently wrong with the technology today. We have just not yet fulfilled all of its promise.

3. Mobility and Wireless

Many colleges and universities now have or will soon have ubiquitous wireless access for laptops. At Carnegie Mellon University or Drexel University, two of many possible examples, one can wander around campus with a laptop always connected to the university backbone and thus to the Internet. Soon all devices on a campus—telephones, computers, PDAs,

We've done the easy stuff by adding wireless hardware. Now we have to do the hard stuff, which is to make the paradigm shift from wired to mobile computing. This means that we have to stop using our mobile laptops as untethered desktop computers and find real mobile applications for them.

In the early days of television news, a station simply took the newscaster, sat him (yes, it was always a him in those days) in front of a TV camera, and broadcast the image of him reading the news. If there was a major train crash, people in the field would telephone or Teletype the news to a central news office, where the story would be put together. The newsmen would then read the story to the hordes of TV watchers. We simply hadn't made the paradigm shift from radio to TV.

literature students live a semester in France and still attend classes in Florida or California at the same time? Why can't students do global market, power grid, or epidemic simulations that require them to gather real-time data in the field? The question we have been asking is, "What can we do if everyone has a mobile phone and a mobile computer?" Instead, the question we should be asking is, "What wonderful things can we do if everyone has mobile network-connected intelligent devices?"

4. The "Information Grid"

For the first time, commercial firms see education as a profit center. The connection of tens of millions of households and hundreds of millions of people to the Web—the information grid—means that

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net appliances, and so forth—will be able to chat with each other and will have Net access. Unfortunately, this doesn't really solve any problem except the mobility problem. It allows my desktop machine to become a mobile laptop machine or a mobile PDA. I can view Web pages on my mobile phone and can make telephone calls on my computer or PDA. I can take my laptop computer to a conference room and have it connected to the Internet during a meeting. I guess this is good, even if I may not really need my laptop to be connected to the Internet in a meeting and even if it would be easier and cheaper to have wired Internet connections in the conference room. I can also do computing outside, under the trees. I guess that's good too, if the trees are very thick with leaves and the sun is not too bright. Otherwise it is impossible to see a laptop screen outside.

In a few cases where it would be prohibitive to physically wire a building, wireless makes good sense, but in most other cases, there is something missing.

How would that train crash be covered today on TV? There would be filmed footage of the crash scene. There would be live footage of the scene. There would be filmed and live footage of the anxious relatives at the train station, with interviews of victims' family and with train and government officials of all stripes. There would be video simulations of the last few minutes before the crash. There would be archival footage of similar crashes. There would be home video of victims. In five minutes, the viewer would have seen more details of the crash than most investigators would see in a week.

We are still mostly in the reading-the-news-on-TV mode with our wireless efforts. But if we dare to, we can dramatically change our labs and our teaching with this new technology. Why can't distributed-learning students, for example, participate in a biology lab without being there? Why can't we give them a real frog in a lab in South Carolina and have them dissect it from their homes in South Dakota or Texas? Why can't French

anyone can deliver rich instructional content over the Web at very low cost. What today is a trickle of offerings outside of traditional higher education will soon become a deluge that will wipe out the unwary and those slow to adapt. For a while, prestige will protect some institutions, but Disney, Sony, Ford, and even Zingerman's Deli in Ann Arbor now offer training that directly competes with college and university offerings. Once people realize, as they soon will, that the learning experience they get is more important than the name of the institution they get it from, traditional higher education institutions will have to adapt.

Traditional colleges and universities offer lodging, food, athletics, cultural events, physical libraries, medical care, counseling, and a host of other goods and services bundled together with courses. The information grid will allow institutions to sell just those parts that the consumer wants. And the information grid will ultimately force colleges and universities—if they want to continue to

exist—to unbundle their services in order to compete with nontraditional offerings.

Beyond the physical campus resources that some colleges and universities have already unbundled, the notion of courses will be changed by the information grid as a delivery system. The current idea of a course is a collection of related material that a student is expected to master to some degree in a fixed amount of time. But if one wants to learn basic chemistry, why pick the amount of material that some professor thinks most students can master in twelve weeks as a course? With the information grid, learning can be broken down into topics much smaller than a course, allowing a student to create his or her own course of study at a much lower level. This also allows students the time to gain mastery over each

she has a very difficult time with a more advanced course when she never really mastered the material it was based on?

Obviously, everyone would prefer a surgeon who had mastered all of the courses in medical school. When someone is cutting into your brain, you do not want to know that she got a C in brain surgery. And travelers would certainly be unhappy to discover that the pilot of their plane only squeaked by in his course on navigation. If we could afford to, we would like to control mastery and content and give students as much time as they need to master the content. There would be no grades because the only possibilities would be an A+ or an incomplete. But we can't afford to do things this way, and we won't ever be able to as long we insist on keeping to our old educational paradigms.

common interface that they will quickly learn to use effectively.

There is no affordable way to do anything with instructional technology without having the infrastructure in place. A CMS is a fine, effective way to do that. But the CMS does not do very much to assist faculty in creating Web content. This becomes a "Field of Dreams" problem. If we build a wonderful CMS infrastructure, will faculty put wonderful material on it? Many would if they could.

The Portal

Every software vendor sells a portal version of its software. Every CMS has a portal version. Blackboard, PeopleSoft, Oracle, SAP, and hundreds of independent vendors offer portals, not to mention JA-SIG's uPortal and the host of

A college or university needs to have a portal that is extensively customized individual and that can be personalized to allow each individual

topic. In a traditional course, a student has to move on with everyone else in the class, has to do things in the same order as everyone else, and has to cover exactly the same material as everyone else. Now learning can become learner-managed rather than instructor-managed.

The three basic parameters of a course are (1) the content or amount of material, (2) the time allotted for the course, and (3) the level of mastery. Any two of these can be fixed, but the third must vary. For example, if we control the required content and the degree of mastery (e.g., the grade), then the time it takes to master the material will vary for students of different abilities and interests. But colleges and universities have traditionally fixed the content and the time and have let the degree of mastery vary. This has forced students to "get through" a course even if they have not mastered the material. Then, if a student earns a C in Spanish 101, she moves on to take Spanish 201, where she will compete with students who got A's in Spanish 101. Is it any wonder that

5. Leveraging Technology for Teaching

To best leverage technology for teaching, a higher education institution should have three important elements in place: (1) a course management system; (2) a single, single-sign-on portal; and (3) instructional technology support.

The Course Management System

A course management system (CMS), such as Blackboard or WebCT, is the communications infrastructure that enables courses to be online. It provides e-mail lists, chat, discussion groups, drop boxes, and a uniform Web interface to attach Web pages and links to online and local information. All courses and seminars should be on the CMS. Institutions should give all faculty members who are teaching a course a presence on the CMS and then should let the faculty add things as they will. Some will leave it as it is or simply add a handout. Others will add wonderful material. Regardless, students will have a single place to go for all of their courses and will have a

homegrown portals. Some colleges and universities are installing separate portals for students, for faculty, and for staff. Others are simply putting the word *portal* on their home pages and declaring portal victory.

There's no doubt that portals are a hot topic, but they are not usually thought of as a critical way to leverage technology for education. They are. They take the mundane plumbing infrastructure of a CMS and extend it to a tool that increases the productivity of faculty and staff and makes the technology more accessible. To get the full benefit of a portal, however, an institution needs a single portal with single sign-on for everyone. A college or university needs to have a portal that is extensively customized by the system for every individual and that can be personalized to allow each individual to work the way he or she works best. And the portal should give every user access to *all* of the resources that each person commonly uses from his or her computer. This can't be done with a bunch of links. Links within a portal should be a last

resort, used only when cameos can't be used instead.¹

Half the battle in using information technology today is finding what is needed. A portal gives everyone quick access to all the things they need, with no unnecessary clutter. A large part of Microsoft's .NET effort is to build customizable, personalized content that links together common tasks and that is available from desktops, laptops, palmtops, and network appliances of all kinds. A portal does nearly all of this.

Instructional Technology Support

A CMS and a portal largely solve the IT software infrastructure problem. But they do not address the problem of creating the content that these systems need. Faculty can build simple Web pages.

Colleges and universities need to cooperate to provide such content. For online simulations, institutions should band together in a consortium to collectively build a Multidisciplinary Educational Simulation Archive (MESA). No one college or university can afford to do this itself or would even have the expertise to do so. Princeton University, for example, has no medical school and would therefore not be able to contribute to building surgical simulations, but it does have significant expertise in physics and math. By sharing the work among many colleges and universities, with institutions working in those areas in which they have the greatest expertise, and by sharing the common MESA library—free for K-12 and higher education—we could quickly create a large and growing library

make a big deal over the digital divide because this problem is so much easier to solve than the real problem. Just throw enough computers at the digital divide problem, and—some think—our education system will be saved. And by doing that, we avoid solving the hard problem of hungry children going to crumbling schools to be taught by unqualified and uninterested teachers. We avoid the problem of children living in drug-infested neighborhoods and going home to conditions that are hostile to learning. We avoid the problem of children having children, children bringing weapons into schools, children terrorizing other children, and children dropping out of schools at alarmingly high rates. Giving these children computers and Web access will not address these problems,

by the system for every
to work the way he or she works best.



With almost no additional effort and no knowledge of HTML, they can use text processors (e.g., Microsoft Word) to build Web pages. If faculty can also have nearly anything digitized through IT support, they can build quite elaborate Web pages on their own. This can't be done without an appropriate organization of Web servers, automatically mounted and shared file systems, and an organization ready to support faculty IT needs. But if faculty can do the simple stuff themselves, the IT folks will be free to work on the harder stuff. Online simulations, for example, are—and are likely to remain—the most difficult Web content to produce. They are also potentially the most useful things that can be offered on the Web. If there were a way for ordinary faculty to produce or obtain customizable online simulations for the Web, this would greatly enhance teaching and learning at both brick-and-click and mortar institutions and at every Web-enabled device connected to a distributed-learning facility.

of interesting online content, content that anyone could include in a Web site. And since the institutions that create the MESA will have planned for its usability by ordinary faculty from the start, the simulations will be easy to use. All MESA simulations would have the same Web interface (called an "API" by IT folks) and would be able to be inserted into a Word document with just a mouse-click or two. A user would go to Word's *Insert* menu and then click on *MESA Simulation*, and the simulation would be added at the insertion point in a Word document. The user could then right-click on the simulation, select properties, and customize the simulation as necessary. That's how easy it can be.

6. The Digital Divide

The digital divide is a red herring. It is a tempting diversion from the real problem, which is that poor children and children in environments unsupportive of education don't do as well in school as their better-off peers. We're tempted to

and until we address these problems, nothing we do to solve the digital divide will have any effect.

In the Flatbush section of Brooklyn, New York, the 4,000 students at Midwood High School are crammed into a decrepit building designed for 2,200 students. The three science labs lack electrical outlets and exhaust systems, and the maximum capacity of the library is 63. Half the students choose Midwood as a magnet school; the other half, who are homogeneously mixed in, are randomly selected from the racial and ethnic mix of the surrounding neighborhood. The school is 43 percent black, 29 percent white, 18 percent Asian, and 10 percent Hispanic. Teachers struggle with overcrowded classes, ancient equipment, and the lack of money that plagues most inner-city schools. We might expect that there would be a high drop-out rate, a high crime rate, chaos, and lack of learning as a result of these sad conditions, but we'd be wrong. Ninety-nine percent of the students graduate and go on to college. In

1998, fifty seniors went to Ivy League schools, and members of the graduating class were offered over \$28 million in scholarships. Thirteen of Midwood's students, the highest number from any single high school in the nation, were semi-finalists in the prestigious Westinghouse science talent search. Five previous winners of the talent search have gone on to win Nobel Prizes. Why does this school do so well? Because of the commitment and dedication of the principal and teachers. A zillion computers would not have had this effect. This school solved the real problem and has seen great results.²

The situation at another school illustrates the futility of throwing money and technology at the problems of inner-city education. At this elementary school, in a very poor neighborhood, there is no possibility of giving the students computer access. But they can get handheld calculators for only \$5 each from Texas Instruments. Many teachers have quit teaching their students basic arithmetic skills and instead have students do the work on calculators. After all, they reason, students in today's technologically advanced world will never need to add or multiply numbers by hand. It's better to skip the tedious task of memorizing multiplication tables and get right to the task of solving problems. But the result can be seen in a sixth-grade class. The teacher gives his students, armed with their calculators, a fairly simple problem: "The *Voyager 2* satellite was launched in August 1977 and reached Neptune in August 1989. How many months did it take?" Virtually all of the students are baffled. They don't know which numbers to punch into their calculators. Sure, if you tell them—1989 minus 1977 times 12—they can key in the numbers and get the right answer. Most of them know how to use a calculator. But they have no idea how to solve a math problem.³ Similarly, what good is a word-processing program if a student knows how to use it but can't write a literate paragraph?

On the other hand, according to media reports, some elementary school students on the upper side of the digital divide were recently discovered to be using their computers to conduct transactions with students from the lower side of the

digital divide. The wealthier students, whose parents had home computers with Internet access and color printers, were downloading and printing pornographic pictures and selling them to students whose parents could not afford computers. Perhaps we should admire the wealthier students' grasp of economics, but is this the use we'd like computers to be put to when we solve the digital divide problem?

According to the U.S. Census Bureau, 98.3 percent of homes had televisions in 1998.⁴ This is a technology available to everyone. At some homes, the TVs are used only when homework has been done, and then they are often tuned to PBS or the Discovery Channel. In other homes, "Beavis and Butt Head" and similar programs are the norm while homework is neglected.

Putting a child or a teacher in front of a computer does not mean that either the child or the teacher will make any effective use of it. The same paint and canvas can be used to make a *Mona Lisa* or a monstrosity. Giving all children canvas and paints will not transform them into painters with the talent of Leonardo da Vinci. And giving all children computers will not get them jobs as Java developers or telemedicine specialists. First, and most important, we must make education compelling and entertaining. Students, parents, teachers, and administrators need to believe in the importance of education and need to believe that almost all students—with enough work and dedication—can excel. *e*

Notes

1. Data cameos are a small amount of data from a Web site or database. Application cameos are a single field from an application that appears in a portal channel into which data may be entered for the cameo application. Cameos allow a portal channel to have just the minimum data required, instead of a whole Web page, or just the smallest appearance of an application. Using cameos instead of links greatly reduces the physical size of channels and reduces the number of mouse clicks required to get to information.
2. Anemona Hartocollis, "Thirteen Midwood High Students Take Westinghouse Honors," *New York Times*, January 13, 1998, 3.
3. "An Inverse Digital Divide," *Wall Street Journal*, December 15, 2000, 1.
4. See Section 18, "Communications and Information Technology," <<http://www.census.gov/prod/2001pubs/statab/sec18.pdf>>, in U.S. Census Bureau, *Statistical Abstract of the United States*, <<http://www.census.gov/prod/www/statistical-abstract-us.html>> (accessed March 11, 2002).