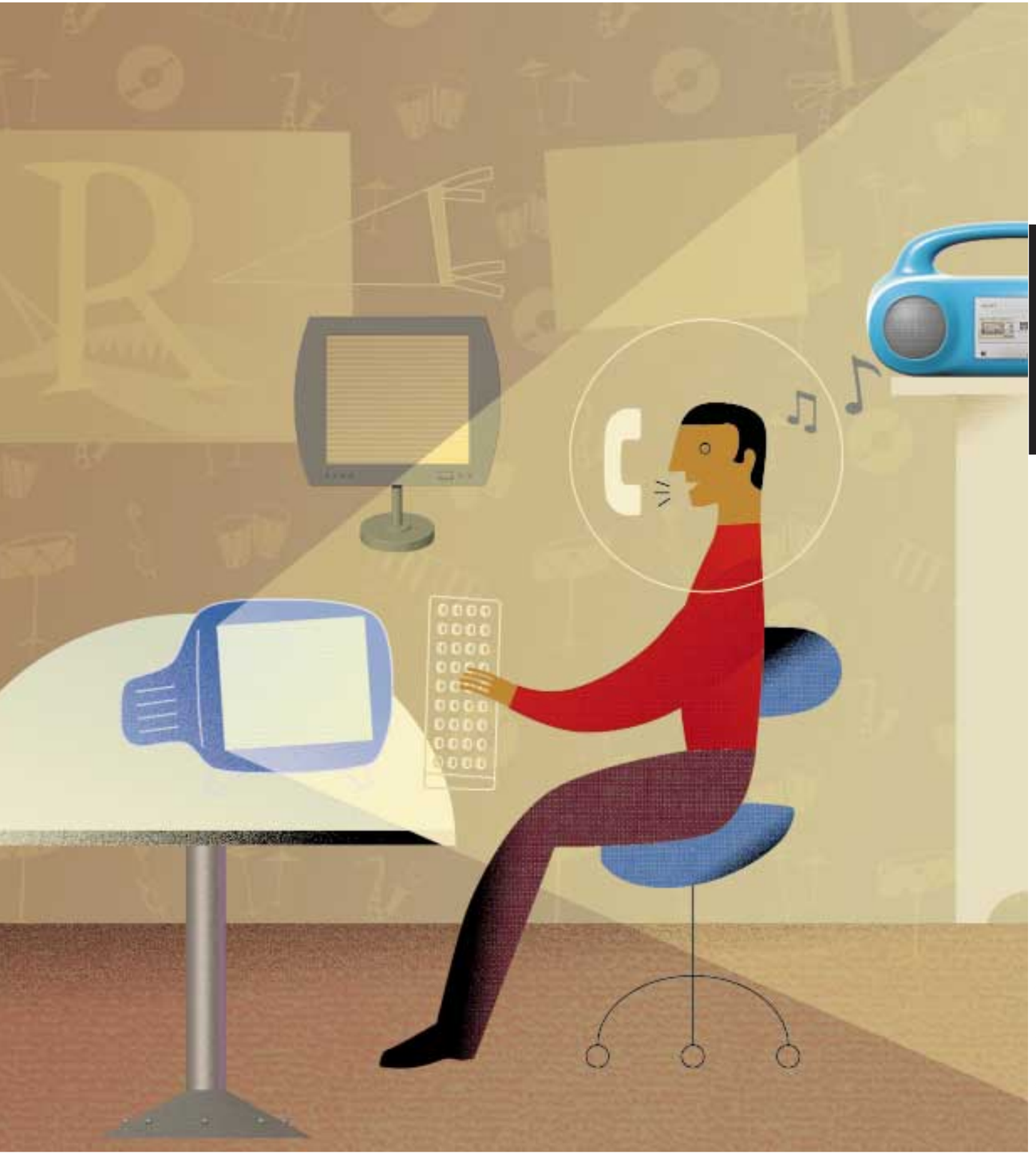

ILLUSTRATION BY BRYAN LEISTER

The INFORMATION-AGE Mindset

Changes in Students and Implications for Higher Education

By Jason L. Frand

Most students entering our colleges and universities today are younger than the microcomputer, are more comfortable working on a keyboard than writing in a spiral notebook, and are happier reading from a computer screen than from paper in hand. For them, constant connectivity—being in touch with friends and family at any time and from any place—is of utmost importance. And they will be assuming responsibility in a world of incredibly rapid change. Will television and the Internet be distinguishable in ten years? Will the U.S.

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Mint still print "money"? Will anyone go to a "bank"? If the U.S. Post Office still exists, what will it deliver? Will textbooks be printed? How will journals be distributed? Will libraries be only electronic collections? Where will our alumni go to upgrade their knowledge and skills? Perhaps most important, what will be the role for colleges and universities in this new environment?

The Information-Age Mindset

Over the past three decades I have observed many new ("new" meaning different, not better) attributes of student behavior that I believe will have a profound impact on our educational institutions. For the past few years, only a small number of students with these attributes have entered our doors. However, over the next few years these students will become the majority, spreading like a tidal wave across higher education and demanding changes in the way we operate.

I have identified ten attributes reflecting values and behaviors that make up what I call "the information-age mindset."[1] The first four relate to broad observations of change ("Computers Aren't Technology," "Internet Better Than TV," "Reality No Longer Real," and "Doing Rather Than Knowing"), three address how people do things ("Nintendo over Logic," "Multitasking Way of Life," and "Typing Rather Than Handwriting"), and the last three are subliminal needs conditioned by the cyberage ("Staying Connected," "Zero Tolerance for Delays," and "Consumer/Creator Blurring"). This information-age mindset, distinctly different from the mindset of those of us who have transitioned from the industrial age, is common among students growing up in the globally connected, service- and information-intense, digitally based culture.

Computers Aren't Technology

Alan Kay, a member of the 1970s Xerox PARC team who went on to help create the Apple Macintosh, has described technology as "anything that isn't around when you're born."[2] Stated another way, if you can remember using your first one ever, it's technology. For most of us with an industrial-age mindset—those of us who are in our more mature years (say, over thirty)—telephones, automobiles, and television[3] aren't technology, but computers, the Internet, the Web, and the expanding world of cellular telecommunications are all technologies. Technology, then, to the information-age generation, is everything that surrounds computers and is made possible by computers but only incidentally the computers themselves.

The past couple of decades have seen a flood of new digital technologies, from the VCR to an incredibly sophisticated new generation of personal digital assistants, or PDAs (pagers, Palm Pilots). Extrapolating only slightly from today's available technologies, one can imagine a PDA with the power of a high-end workstation, slung over the shoulder like a slim handbag, able to connect to the Internet and supporting instant multimedia communications anywhere on the planet. The expectation is that such a technology—the natural integration of today's cellular phone, Palm Pilot, and lightweight laptop—will be commonplace in just a few years.

The phrase "incredibly sophisticated" in the last paragraph is an industrial-age mindset view of the innovations that are emerging on an almost daily basis. When these new devices are introduced, the information-age mindset reaction is "What took so long?" rather than "Wow!" Young people naturally gravitate to these kinds of interactive, input/output devices. They make the devices work without a manual, without the instruction set, as if the device is hardwired into their psyche.

Internet Better Than TV

Professor Jeff Cole at UCLA is involved in a worldwide study of the impact of the Internet on society. One preliminary finding is that during 1998, for the first time since television was introduced fifty years ago, the number of hours young people spent watching TV decreased. This time was transferred to the computer, with its Internet connectivity. Cole believes it's the interactivity that has drawn them from one tube to the other.[4] These students are using the Web as their primary (if not sole) information source: what movie to see, what's on TV, where to shop and what to buy, as well as what's happening in the world. Neil Postman, in his 1986 book *Amusing Ourselves to Death,* raised the issue of the overpowering impact of TV to trivialize problems and curb the critical-thinking skills that come from engaging written ideas. Yet today, young people are reading and writing (typing) more as they participate in chat rooms, e-mail exchanges, and bulletin boards. We cannot leap from "interacting on the Net" to "critical thinking," but at least the opportunity is presented to engage ideas in a more compelling format than passively watching television.

Unfortunately, many of our students do believe that everything they need to know is on the Web and that it's all free. Although there is a tremendous amount of data available over the Internet, finding the information sought is not easy. With a search engine, thousands of hits may be returned for one search. Rather than using more advanced search techniques to narrow the field, we tend to simply use the first items listed, even if they are the least beneficial. Furthermore, for any given Web site, differentiating between fact and fiction, or personal opinion and substantiated research, is extremely difficult. Although it is true that there is a significant amount of high-quality information available via the Web, it is also true that there is even more unvalidated and unsubstantiated data passed off as "fact." Unlike traditional written materials, for which the sheer cost of publication encourages editorial review to some degree, most Web sites do not even have the most rudimentary "quality" indicators such as a posting date, the authority or expertise of the individual or group that created the site, contact information for the author or producer, or citations for major facts or assertions. How can we trust information if we don't know its source? Frequently the most valuable information—information that has been synthesized, cross-referenced, and packaged for easiest retrieval or interpretation—is licensed and requires payment. Thus the Web is a vast (and largely uncharted) sea of data. On the one hand, students have access to all its riches. On the other hand, they must learn to search it to find the specific information desired and to draw their own conclusions.

Reality No Longer Real

Remember the old saw "Believe none of what you hear and only half of what you see"? Today we must update this to "Believe none of what you hear and none of what you see." Three hundred years ago, if a person saw a sketch of a lion, a sea serpent, and a human being, the viewer had no way of knowing whether or not the figures actually existed. Knowing that humans existed, and reasoning that the drawing was based on something real, one could easily extrapolate that the lion and sea serpent were also real. It wasn't until the invention of photography in the 1830s that people could trust that a picture represented reality. But now, ironically, we have entered a

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period of such advanced data-manipulation capability that photography can no longer be trusted. For example, in the movies, Forrest Gump shook hands with Presidents Kennedy, Johnson, Nixon, Bush, Ford, and Clinton. For young people, a virtual reality simulation (such as a flight simulator or a holographic tour of a city) may be as real as the real experience. (For an outstanding novel focusing on this perspective, read Orson Scott Card's *Enders Game.*)

This issue of reality has a more sinister side, which every user of an e-mail system confronts: when do we know if a message we receive is "real"? In this context we can interpret "real" in two ways: that the sender of the message is who she/he claims to be and that the content is accurate. User authentication (proving we are who we say we are) is a major challenge. It is very easy to create an alias and use it to send e-mail. As more and more of our communications and commerce are conducted electronically, being sure we know the "real" identity of the individual at the other end of the wire will become increasingly critical. Of equal importance will be knowing that the content of a message is accurate. An e-mail virus hoax can play as much havoc and be as disruptive as a "real" virus. Just like the viewer of a sketch three hundred years ago, will we be able to distinguish what is real from what is not?

Doing Rather Than Knowing

Today people, goods, and information move quickly and easily to all parts of the globe. The ideas of market-based economies and representative governments are being implemented worldwide. These are the attributes of globalization, and every individual and institution is influenced. The demographics of our colleges and universities today are very different from those of a generation ago, reflecting the shifts in a highly mobile global community. Our campuses are more diverse, with many students with very different languages, cultural backgrounds, experiences, and expectations. And these students will be graduating into a world of tremendous turbulence. Bill Wiggenhorn, president of Motorola University (one of the many nontraditional educational institutions that have recently emerged), has stated that Motorola challenges its students to describe a job of five years ago that hasn't been radically reengineered today and a job today that won't suffer the same obsolescence five years hence.[5]

In such an environment, the industrial-age view of knowledge as a product—"a body of facts accumulated by mankind" (*Webster's Dictionary*)—must be reexamined. In the past, the half-life of information was measured in decades and centuries, certainly longer than most individuals' life span. College and university students could learn skills and gain knowledge that would carry them through their careers. Our awareness of change was small (local and national news), and the changes we did see were incremental (viewed as the history of an event).

But today we live in a world in which digital technologies have altered time and space so that events occur in real time, effects are immediate, and reaction times are cut short. In many disciplines, the half-life of information is measured in months and years.[6] From this perspective, what a person can do is more important than what degree they obtained. (Bill Gates, a college dropout, is an icon for many in the information age.) As our students enter the workforce, the ability to deal with complex and often ambiguous information will be more important than simply knowing a lot of facts or having an accumulation of knowledge.

Nintendo over Logic

For those of us with an industrial-age mindset, trial-and-error experimentation was an expensive, time-consuming approach to problem solving. The experimental stage of the scientific method was undertaken only after careful consideration of all available information. We weren't supposed to try something until after thinking through the consequences. But you'll never win a Nintendo game that way! The key to winning in Nintendo is constant, persistent trial-and-error to discover the hidden doors. The fastest way to winning is through losing, since each loss is a learning experience. If it (the game environment) breaks, simply reboot! It's no wonder manuals or instruction sets aren't used by today's students—they aren't needed. When handed a digital gadget, these students turn it on, push the buttons, try the knobs. I can always tell if people are from "my" generation or the "Nintendo" generation by how

they approach a new software package. Do they check out the menus and manual first, or do they begin typing and then search for what they want whenever they need it?

This observation leads to an entire set of difficult questions: How does trial-and-error apply to identifying trends and penetrating inconsistent data? What happens when students can't derive "the answer" from trial-and-error? Are they prepared to engage in more in-depth analysis? What are the implications of such a risk-adverse perspective toward events in general? Does this attitude transfer to other situations?

Trial-and-error learning may provide a more thorough understanding of a number of concepts and their implications. However, it should not be the only approach used. A balance is needed between didactic and discovery approaches.

Multitasking Way of Life

Many young people today are accustomed to watching TV, talking on the phone, doing homework, eating, and interacting with their parents all at the same time. They don't concentrate on one activity at a time. When I was a kid (don't you hate that phrase?), if we didn't like what was on TV, we had our choice of two or maybe three other channels. Today there are dozens or hundreds of channels, depending on the provider. If we don't like a Web site, we click to another. Our students have an exposure, albeit very thin, to a breadth of places, ideas, and cultures that previously only the well-traveled could boast. Television has given us a veneer of information about everything happening anywhere in the world. CNN's *Headline News,* for example, brings us a very broad, sound-bite view of events. On MTV, several hundred images may appear in the course of a five-minute video. Our audio and visual channels are bombarded with inputs.

Stan Davis, a prolific business futurist, sees the competition to attract an individual's attention as one of the most challenging issues of the twenty-first century.[7] Information overload, a serious problem today, will be further exacerbated with the continued exponential growth of the Web and the doubling of scientific research findings every few years. One response is our attempt to multitask, for example to try to read e-mail while talking on the telephone or listening to a lecture. Spending quality, focused, and extended time investigating a problem is a luxury reserved for fewer and fewer of us. For the vast majority, channel-surfing is the norm.

Typing Rather Than Handwriting

A mother recently gave her high-school-age son a gift from his grandmother and asked him to write a thank-you note. He said he would type it. She said, "No, it's not as nice, so please handwrite it." (This represents an industrial-age mindset clashing with an information-age mindset.) When she pressed him a couple of days later, he said, "Mom, I don't know how to write." Listening to this story, I realized that my children (both in their mid-twenties and outstanding "writers") prefer keyboards to graphite, and why shouldn't they? We installed our first home computer in 1980, and they "typed" everything from then on. The hundreds of hours my generation spent practicing penmanship were spent by our children at the keyboard. And maybe even more important, typed prose is always easy to read, even weeks after being typed; it can be checked for spelling errors, searched for key words, retrieved after filing, and easily manipulated for reuse.

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But the power of the word-processing package goes well beyond simple improvements in legibility, spelling, and filing. Word-processing holds the power to easily manipulate the data—the words—to obtain a significantly better output. In many ways it becomes an extension of our own memories, enabling us to capture and retain material for use in more critical problem-solving and decision-making situations. For example, I could never compose at the typewriter (I'm definitely not a linear thinker). However, I can bounce all over the screen with a word processor. I can put down an idea, expand it, take it apart, and then reassemble it in a more meaningful way. Similarly, spreadsheet applications enable us to create models to evaluate situations, solve problems, and make decisions. It's not the "typing" but the power behind the "typing" that is so important today.

Staying Connected

Advanced telecommunication connectivity is a natural part of living for information-age students. Beepers, cell phones, and PDAs are standard operating equipment. The idea of not being in touch anyplace, anytime—even in the middle of a classroom or a movie theater—is unthinkable. Yet "staying connected" is driven by Metcalfe's Law. Robert Metcalfe, another of the 1970s Xerox PARC team and the inventor of Ethernet networking technology, observed that the value of the network increases exponentially as the number of users grows. (For example, telephones wouldn't be of much value if only two people had access.) Metcalfe's Law applies to "connectivity" in general: the greater the number of people involved, the more valuable will be the communication technology. Beepers and cell phones increase in utility as more and more people use them. As more and more homes and offices are connected to the Net, the more valuable that means of information distribution becomes.

Ubiquitous connectivity, then, drives

a more fundamental change in concepts of distance and location. Living in a fully connected world means that individuals can participate in real-time dialogues from anywhere, at any time, communicating using beepers, telephones, the Net, chat rooms, and teleconferencing. Where one works or studies—in the classroom, in the office, in the home, in a library, or on the road—will be determined by pedagogical, social, motivational, or biological factors, not by yesterday's synchronous constraints.

Zero Tolerance for Delays

It is human nature to want the immediate gratification of our desires, not just physical but informational as well. Having grown up with automatic teller machines, information-age students expect banking services 24x7. We're all vulnerable to this desire for immediacy. We can barely tolerate a phone ringing more than three times when we call someone. It may be three in the morning, but if I call a toll-free number for a service, I expect someone to be at the other end of that line. With the use of e-mail has come the feeling that we need to respond, both in terms of acknowledgment and content, in real time. People apologize for not responding to e-mail immediately. They feel compelled to answer questions and provide information, often without taking adequate time to think through the consequences of their actions. The whole concept of time (and time compression) has changed dramatically. When one speaks of an Internet year like a "dog year" (i.e., one human year is equivalent to seven dog or Internet years), this is time compression at light speed. Voice mail and e-mail are more efficient and less formal, which implies "I want a quick response." On the other hand, they create time-expansion capabilities. We can store and retrieve messages until we're ready to reply, which also implies "at your convenience."

Consumer/Creator Blurring

When one of my students wrote a term paper in the late 1980s, she typed some material into the computer directly from an encyclopedia. When I told her that one of these days we would have the encyclopedia on a disk, she replied, "Do you mean I could then just cut and paste?" The updated version of this timeless story occurred in my class this past year when a student asked, "Rather than rewrite what I've found on a Web site, can I just put in the link and you can read the original?" These situations are clearly the forerunner of the current MP3 fiasco. In today's parlance, there is no distinction between the owner, the creator, and the user of information. Web protocols are such that if you see something you like, you just cut and paste it from the Web page. After all, the tools for doing this are built into the Web editors. The entire structure of HTML supports this sharing/borrowing/taking (dare I say "stealing"?) of others' intellectual property. In the physical world, dual-cassette recorders make copying an audio- or videotape easy. Why should copying a CD, a computer application program, or material from an encyclopedia be any different?

There is an interesting twist to this concept in the commercial world of computer programs. A common practice of software vendors is to release a product that is known to be "buggy" and have the users "de-bug" it (by calling it a beta-test version). The open-source movement blurs the creators/users relationship even more by formally extending the development process to the entire programming community.

So What Does All This Mean for Higher Education?

Given the mix of new attitudes and behaviors—the information-age mindset—what should we as individual educators, and collectively in our institutions, do (if anything)? I would like to answer this question by sharing a vision for higher education. In this vision, we will combine the potential of computer, communication, and information technologies with the pedagogical changes that need to occur in light of the prevalence of the information-age mindset.

To develop the vision, I would like to draw on an important lesson from the commercial sector.[8] During the 1970s and the early 1980s, the business world experienced an interesting paradox: companies that invested heavily in information technology went out of business at about the same rate as those that did not invest in information technology at all. Those that did not invest were as successful as those that did invest. How could this be explained?

The research findings are very revealing. As computer, communication, and information technologies entered businesses, companies concentrated their initial investments on gaining efficiencies with traditional processes. For example, companies replaced bookkeeping clerks with computerized accounting systems and replaced stock clerks with automated inventory systems. But these investments had no positive impact on the bottom line. By the late 1980s, however, a few major breakthroughs not only yielded a positive return on information technology investments but previewed the changing dynamic that has since swept the entire business world. A couple of pioneering successes were American Airlines' frequent flyer program and American Hospital Systems' customer-controlled inventory management system. In each case, the value added came from changing the nature of the relationship between the company and its customers. The company not only did things differently but did different things. The focus of these programs was external effectiveness rather than internal efficiency. They created new partnerships between their organizations and their customers. They changed the rules of transaction from mass marketing to one-to-one marketing and from mass production to mass customization. These changes are being reflected in every business today: for any company to compete, it must be willing to challenge everything that has gone before and to completely rethink the relationship between the company and its customers—to reconsider its customer services, its organizational structure, and its business processes.

Higher education is experiencing a similar paradox. If teachers continue to teach in the same way that they have always taught, there will be little value added from classroom and campus networks. If students approach learning in

the same way that they always have, computer labs and laptop programs will be unnecessary expenses. Until the nature of the educational relationships change in the classroom and at the institutional level, we will not realize the full value of the computer, communication, and information technology investments that we are making today. We need to think in terms of transforming the educational experience so that it is meaningful to the information-age learner.

This conceptual change must embrace a substantial modification in the nature of the relationship between the student and education and, therefore, between the student and the institution. Let me give an analogy. University computer networks today consist of nodes at every office, classroom, and library seat. But this network concept can be expanded. We need to build an extended educational infrastructure that parallels our physical network infrastructure. When viewed from the perspective of a human network—a community of lifelong learners—the educational infrastructure becomes a means for broadening and deepening the educational experience of students and for enhancing and extending the educational experience of alumni. Each of our current and past (and future?) students is a "node."

Baccalaureate students spend about four years on campus and then perhaps another forty years or so in their various occupations. So for less than 10 percent of their student and professional life, they are in direct, physical contact with our schools. But throughout their entire career, they can benefit from that 10 percent of time on campus. From this perspective, one goal of higher education needs to be to provide on-campus students with the tools, knowledge, and skills they need to continue to participate as members of our learning community long after they graduate. The exact skill set needed is yet to be determined. A challenge is to introduce new learning and teaching approaches that prepare students to integrate their personal aspirations, career goals, and educational experiences and to continue to do so over their lifetimes. Through the continuity of links back to the academic base, the individual will have opportunities to grow through and benefit from extensive alumni and professional networks. (And as a secondary but important benefit, the institution may have the kind of alumni network that most schools only dream of today.)

This vision challenges our institutions not only to look at new ways of doing what we have always done but also to look at doing new things. Students with an information-age mindset expect education to emphasize the learning process more than a canon of knowledge. They want to be part of learning communities, with hubs and spokes of learners, rejecting the broadcast paradigm of television (or the note-taker in a lecture hall). Our institutions need to expand their primary focus from the internal, on-campus, temporal experience to include the external, global, lifelong experience. For example, alumni need to be able to "attend" classes as virtual members, participating both as peers and as mentors for their on-campus counterparts. Distributed education, a combination of in-class and "distance learning" options, will become a natural part of higher education.

We have the pedagogical opportunities to build on the various attributes of the information-age mindset and prepare students to participate in a community of lifelong learners. Replacing the phrase "sage on the stage" with "guide on the side" reflects the idea that the instructor needs to play a more Socratic role, posing questions and guiding the learning process, rather than taking an ecclesiastical approach, providing "the word" on a subject that the student is to "learn" (memorize) and repeat back in some format. Evolving educational techniques, such as the studio approach to learning mathematics and science, have shifted the emphasize away from faculty-centered lectures to cluster learning environments intensely supported by computer, communication, and information technologies. The use of e-mail dialogues for students in basic language classes forces real-time use of the language, greatly enhancing students' acquisition of language skills. Field-based research projects, which include peer-review components (analogous to faculty peer-review processes) before "publishing" on the Web, force students to engage real-time data from a comprehensive multidisciplinary perspective. This is not to say that we should replace all our current practices with something new ("new" meaning different, not better). There will always be a role for the lecture format, and there are learning situations in which computer use is totally inappropriate. The goal must be to match the appropriate use of technology with the content, the instructor's personal style, and the students' learning style.

The outlook of those we teach has changed, and thus the way in which we teach must change. The world in which we all live has changed, and thus the content we teach must change. The industrial age has become the information age, and thus the way we organize our institutions must change, as must the meaning we attach to the terms "student," "teacher," and "alumni." The challenge will be for educators and higher education institutions to incorporate the information-age mindset of today's learners into our programs so as to create communities of lifelong learners.

Notes

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1. I recognize that these are broad generalizations, not all of which apply to each individual.
2. Alan Kay, lecture on January 10, 1996, "Special Topics Course," UCLA, winter quarter.
3. I remember getting our first television when I was thirteen, so for me, television was a technology by Kay's criterion.
4. E-mail correspondence with Professor Jeff Cole, October 29, 1999.
5. Bill Wiggenhorn, keynote speaker, AACSB annual meeting, Atlanta, Georgia, April 1998.
6. Even for those disciplines for which the half-life of information is longer, students' information-age mindset requires change in traditional perspectives.
7. Stanley M. Davis and Christopher Meyer, *Blur: The Speed of Change in the Connected Economy* (Reading, Mass.: Addison-Wesley, 1998).
8. The institutions of education and commerce are different, and there are very good reasons for not asking for a "business case" when undertaking educational or research objectives. However, that doesn't mean that our educational institutions cannot learn from the commercial sector.