

New Technologies and Their Promise for Higher Education

*Address to the First Harvard University Conference on the Internet and Society
May 29, 1996*

I WANT TO TALK today about the Internet and higher education. What changes are taking place in universities as a result of this recent advance in information technology? Are the changes significant, and are they likely to be long-lasting (as I believe they are)? If so, why?

The questions are obviously important, in part because our conclusions will determine whether Harvard and other institutions should make very large financial investments in the next five to ten years, at a time when flexible resources are clearly constrained.

But more important than the financial issues are those of educational substance. Any deep transformation in communications – in our ability to gain access to data, information, and ultimately knowledge, and in processes that can help us to discover, invent, teach, and learn – holds the potential to have profound effects on higher education. So as we assess the new information tech-

Science and Technology

nology – the Internet – we have to make the right bet, because the stakes are high.

When I refer to the Internet, I mean to use the term as shorthand for a cluster of technologies that includes networked personal computers, hypertext and hypermedia, the World Wide Web, and other adjuncts.

This cluster has, during the past few years, already begun to have a dramatic impact on the ways that many students and faculty are approaching the whole activity of teaching and learning. In the context of Harvard and at least some other universities, these changes are more dynamic and pervasive than any previous breakthrough in information technology during this century – including the introduction of the personal computer itself. The effects are visible in nearly every part of our own campus, as well as elsewhere in higher education.

From one point of view, the Internet marks just one more point on a long continuum of inventions – one that has unfolded over the course of the last century and a half – from the telegraph and cablegram, through the telephone, radio, recorded sound, film, television, early calculating machines, and then the earliest computers.

But we know that certain events along a continuum can represent much more than another simple step in a natural, gradual progression. There are moments of real transformation, and the rapid emergence of the Internet is one of them.

+ + +

Many inventions (such as radio, film, and television) have of course had a massive effect on society – on how people spend their time, entertain themselves, and even gain information. But, in spite of many predictions, these particular inventions have had little effect on formal, serious, advanced education. Why should the Internet be any different? Is there any evidence – or a reasoned explanation – for betting on the Internet, when so many earlier inventions have fallen short of expectations?

New Technologies and Their Promise for Higher Education

Let me mention a few facts.

In our Faculty of Arts and Sciences, as well as nearly all of our nine professional schools, teachers and students are on-line, with easy access to the network. E-mail is commonplace. Activity on the Net is heavy at nearly all times of day and night, with the only major slowdown occurring between 3:00 a.m. and 6:00 a.m.

In 1992, we began a retrospective conversion of the catalogue for Harvard's entire library system – the largest university library system in the world – at a projected cost of \$22 million. By next year, full catalogue entries for the approximately thirteen million volumes in our ninety-two libraries will be on-line and searchable in any number of ways. In addition, there are, of course, more and more actual texts, images, and other materials on the Net.

The rate of change and growth is exceptionally fast. A year ago, the Arts and Sciences Web site (which includes many subsites) experienced about 150,000 "hits" in the single month of March. This March, just one year later, the number of "hits" had increased from 150,000 to 2.3 million. There is no sign of a slowdown.

In 1995, the volume of e-mail traffic on the Arts and Sciences network was about 80,000 transactions per day. Twelve months later, the number had grown by about 170 percent, to about 215,000 per day – or about 6.5 million per month.

These figures, let me stress, are only for Arts and Sciences. They do not include our Schools of Business, Design, Dentistry, Divinity, Education, Government, Law, Medicine, and Public Health – or our central administration and various other units.

So if I am asked whether something very unusual – something qualitatively and quantitatively different – is under way, the answer is a clear "yes." And we are only at the beginning.

+ + +

In purely economic terms, we expect to spend something in the range of \$75 million to \$100 million over the next two to three years on academic-related information technology – above and beyond the substantial investments already made since the early 1990s.

Science and Technology

The last time universities experienced such far-reaching change in information processing, along with exponential expenditure growth, was during the last quarter of the nineteenth century and the first quarter of the twentieth. It was then that the huge information systems that we call university research libraries reached their point of “takeoff” in accelerated development.

At Harvard, the moment of takeoff came during the 1870s and 1880s. When that moment arrived, universities were forced to confront many problems – including that of information overload – similar to several of the “electronic” problems we now face.

In 1876, for instance, Harvard’s President Charles Eliot reported that the main library building had become completely inadequate to accommodate the sharp rise in acquisitions. Books, he said, “are piled upon the floors.... Alcoves are blocked up.... Thousands of [volumes] ... have been placed in temporary positions.” He later noted that large numbers of books were being stored haphazardly: “42,000 volumes scattered among twenty-nine [locations] ... in sixteen different buildings.”

The real challenges, however, were not those of space and money. They were organizational and conceptual. How should books be arranged for optimal use? What kind of cataloguing system could be invented to allow rapid access to the huge number of volumes that were now being acquired? How could convenient linkages be created among books and articles in different but related fields? How should library books be integrated into the University’s programs of instruction – especially if the library owned only one or two copies of a book which fifty or sixty students were asked to read for class discussion?

Finally, what was to prevent students (and even faculty) from disappearing into the stacks for days on end, pursuing a subject from book to book, shelf to shelf, unable to discriminate easily among the unlimited number of volumes, or to absorb more than a small fraction of the information available on a given topic? And what could possibly prevent less industrious students from simply browsing their lives away in sweet procrastination?

New Technologies and Their Promise for Higher Education

Some of these fears were not completely new. Anxieties had been building for some time. As early as the eighteenth century, Diderot remarked that “a time will come when it will be almost as difficult to learn anything from books as from the direct study of the whole of the universe. . . . The printing press, which never rests, [will fill] huge buildings with books [in which readers] will not do very much reading. . . . The world of learning – our world – will drown in books.”

Meanwhile, a treatise on public health, published in Germany in 1795, warned that excessive reading induced “a susceptibility to colds, headaches, weakening of the eyes, heat rashes, gout, arthritis, asthma, apoplexy, pulmonary disease, indigestion, nervous disorders, migraines, epilepsy, hypochondria, and melancholy.”

People were warned not to read immediately after eating, and to read only when standing up, for the sake of good digestion. Fresh air, frequent walks, and washing one’s face periodically in cold water were also prescribed for habitual solitary readers. Most of all, it was feared that excessive reading would make people socially dysfunctional, would take the place of direct human contact, and could well lead to a society composed of certified misfits.

Historical parallels are never exact, but the story of university research libraries, and of the habit of solitary reading, has some obvious relevance to modern information technology – especially to the Internet’s ability to give individuals unbounded access to a new universe of information that they do not yet know how to manage at all well.

There is also the serious problem of the very mixed quality of the information available. How do we sort it? How do we gain maximum return on the time and energy invested in searching?

Given this situation, it is not surprising that many people are now asking some of the same questions that were raised in the early days of research libraries – and expressing some of the same fears. The Internet is in fact not easy to navigate; much of its available information is trivial; it appears to be hazardous to the health of at least some people; and it also has the capacity to distract

many people from following what others regard as more serious pursuits.

Some of these concerns can be alleviated by recalling the story of our research libraries and their evolution. Other concerns – such as the worry that the Internet may turn out to be no more educationally useful than radio or television – need to be answered differently.

+ + +

Why is the Internet likely to succeed as a vehicle for real education, when so many other inventions have faltered? Why isn't it simply one more in a long train of distractions? Doesn't it, ultimately, take students and faculty further and further away from books, from the hard work of sustained study and thought, and from direct human contact with other students and faculty?

Let me suggest some of the main reasons why I believe that the Internet is fundamentally different from those earlier electronic inventions, and why I believe it is already having – and will continue to have – such a major effect on higher education.

To begin with, there is the steadily mounting evidence of dramatic change and intensity of use, as I mentioned just a few moments ago. All of this is certainly not a mirage.

More fundamentally, there is in fact a very close fit – a critical interlock – between the structures and processes of the Internet, and the main structures and processes of university teaching and learning. That same fit simply did not (and does not) exist with radio, film, or television. This point is in many respects a remarkably simple one, but – in the field of education, at least – it makes absolutely all the difference.

If I say there is a critical interlock or fit here, I mean nothing more complicated than the plain fact that students can carry forward their work on the Internet in ways that are similar to – and tightly intertwined with – the traditional ways that they study and learn in libraries, classrooms, lecture halls, seminars, informal

New Technologies and Their Promise for Higher Education

discussion groups, and laboratories, and in the writing and editing of papers or reports.

Some of these activities are more cumbersome and less successful when transplanted to the Internet environment. Others are substantially improved. In most cases, however, the new technology acts primarily as a powerful supplement to – and reinforcement of – the major methods that faculty and students have discovered, over the course of a very long period of time, to be unusually effective forms of teaching and learning in higher education.

Specific examples can be helpful here, so that we can see more clearly how the capacities and processes of the Internet relate so closely to the university's traditional forms of education.

For instance, the Internet can provide access to essentially unlimited sources of information not conveniently obtainable through other means. Let us assume for the moment that most of the technical and other problems of the Internet will in time be solved: that there will be, as there are now in the research library system, efficient ways of helping users to find what they want; that there will be procedures for information quality control, and for creating more effective linkages among different bodies of knowledge in different media.

At that point, the Internet and its successor technologies will have the essential features of a massive library system, where people can roam through the electronic equivalent of book stacks, with assistance from the electronic equivalent of reference librarians. In short, one major reason the characteristics of the Internet are so compatible with those of universities is that some of the Internet's most significant capabilities resemble, and dovetail with, the capabilities of university research libraries. Just as the research library is an extremely powerful instrument for learning, so too is the Internet – and for much the same reasons.

In fact, the library and the Internet are being viewed increasingly as a versatile unified system, providing an enormous variety

Science and Technology

of materials, in different formats – so that data, texts, images, and other forms of information can be readily accessed by students and faculty alike. Indeed, we are already well along this path.

+ + +

If we now shift for a minute from libraries to the formal curriculum, we can see that the Internet has another set of highly relevant capabilities: it can provide unusually rich course materials on-line.

For instance, traditional text-based Business School “cases” are already being transformed. I recently reviewed one of the new generation of multimedia cases, which focuses on a small sock-manufacturing plant in China – an Australian-managed plant plagued by serious production and delivery problems, and losing money much faster than it could make either toes or heels.

The materials for this case began with a video tour of the plant, close-up moving pictures of the workers operating their machines – or not operating them – followed by interviews with several managers at different levels in the company’s hierarchy. Detailed production and supply data, financial spreadsheets, and a company report – all of these and more were obtainable in the electronic course-pack.

What one saw, of course, was that the interviews with different people revealed totally different perspectives on the plant’s problems, and the data were anything but conclusive. The company’s official report, meanwhile, served only to complicate the picture further. Students who were taking this course had to analyze not just a text and statistics, but also the whole range of attitudes, expressions, and behavior – recorded on video – of the different executives, as well as the workers.

How many of the plant’s problems were basically cultural – since the key Australian manager spoke no Chinese, and had to communicate with the workers through interpreters? How many problems were the result of a more general human systems failure,

New Technologies and Their Promise for Higher Education

given the fact that the plant was embedded in a larger surrounding bureaucracy? How much of the difficulty stemmed from internal inefficiency, bad organization, and managerial blundering?

What is so effective about cases presented in this way is that far more of the entire human and social – as well as operational and financial – situation can be revealed, and this requires students to deal with a vivid dramatization that is much closer to the complicated reality of an actual company functioning in a particular culture. Suddenly, the case becomes three-dimensional or multidimensional. The viewer has to bring to bear all the skills of a careful observer of human nature, along with those of an operations analyst, a financial analyst, and a scholar of organizational behavior.

In short, the Internet turns out to be an exceptionally fine tool for the creation of densely woven, multilayered, and highly demanding new course materials that are in several respects superior to traditional case studies. Once again, an important component of university learning, the course and its texts, can now be reinforced – in this instance, considerably enhanced – by the introduction of Internet technology.

+ + +

Another point of compatibility between the processes of the Internet and those of the university concerns the basic activity of communication. We know that the constant exchange of ideas and opinions among students – as well as faculty – is one of the oldest and most important forms of education. People learn by talking with one another, in classrooms, laboratories, dining halls, seminars, and dormitories. They test propositions, they argue and debate, they challenge one another, and they sometimes even discover common solutions to difficult problems.

The Internet allows this process of dialogue – of conversational learning – to be transferred easily and flexibly into electronic form. Communication can be carried on at all hours,

Science and Technology

across distances, with people who are on-campus or off-campus. Student study groups can work together on-line; faculty members can hold electronic office hours, in addition to their “real” office hours; and teaching fellows can make themselves available for after-class electronic discussions.

In all these ways, the Internet works to create a significant new forum – a limitless number of electronic rooms and spaces – where one of the most fundamental educational processes – energetic discussion and debate – can be carried on continuously.

It is also worth noting that recent experience suggests that student participation levels tend to rise in the electronic forum. Students who are consistently reticent in actual classrooms are more likely to speak out, regularly and confidently, on the network.

No one should believe that electronic communication can be – or should be – a substitute for direct human contact. But the electronic process has some features that do permit an actual extension of the scope, continuity, and even the quality of certain forms of interaction, even though communication over the network lacks other absolutely essential aspects of “real” conversations in the presence of “real” people.

+ + +

Finally, the Internet may well be having – it is not altogether easy to tell – a subtle but significant effect on the relationships among students, faculty members, and the subject or materials that are being studied in a course.

Let me oversimplify for a moment. The direction of movement in teaching and learning has, for more than a century, been shifting away from a previously established model that viewed the faculty member (or an authoritative text, or a canon of texts) as the dominant presence – as the transmitter – with the student as a kind of receiver.

Since at least the 1870s, the emerging theories of education have stressed the role of the student as an active agent, an ener-

New Technologies and Their Promise for Higher Education

getic learner: someone who asks questions, searches for information, discusses ideas with others, and generally moves ahead as an investigator, discoverer, or adventurous scholar-in-the-making.

In this model, the faculty role, more and more, is to draw students out, to steer but not explicitly control the discussion unless it becomes necessary to do so. The faculty also organizes the structure of the curriculum, individual courses, and class assignments. But the course materials are not likely to be treated as authoritative texts that offer definitive solutions. They are intended to be approached critically, and they are usually arranged in a point-counterpoint way.

This arrangement inevitably suggests that many or even most of the important questions in a course are still open and unresolved, waiting to be discussed and addressed and answered. Faculty play an absolutely vital role in this process, stimulating students to ask the right questions, to search in rigorous and imaginative ways for answers, and to connect their thoughts to a larger set of principles and ideas. But a very large part of the positive charge comes from the students themselves.

We do not have to agree fully with this theory of education in order to see that it has in fact produced very potent results in colleges and universities. We can also see why the structure and basic processes of the Internet technology appear to be so closely linked to – so compatible with – the approach to education that I have just been describing.

The Internet essentially *requires* that the user be an engaged agent, searching for information and then managing or manipulating whatever is found – solving problems, buttressing arguments with evidence, and exploring new, unknown terrain. Students are invited to trace linkages from one source to another. They can easily share ideas with others on e-mail. They ask for comments and criticisms. Their posture or attitude, seated in front of the computer, is to make something happen. And they generally act or pursue, rather than merely react and absorb.

Science and Technology

So, if we step back and look at the full picture that I've tried to sketch, we can, I think, start to understand why the Internet and its successor technologies will not only have a profound effect on society in general – as radio, film, and television previously did – but why it has so quickly and dramatically begun to transform significant aspects of higher education, in a way that previous inventions simply did not.

As I have tried to suggest, the cluster of technologies that we call the Internet has very distinctive powers – a unique ability to complement, to reinforce, and to enhance many of our most powerful traditional approaches to university teaching and learning. We will still need our libraries, our seminars and tutorials, our faculty, books, laboratories, and residential environments. But the new technologies will strengthen much of what already exists, and also extend our capacities.

The Internet is new, it is different, and there is always reason for caution when things are changing so quickly. We need to find the right pace in order to achieve the best possible results for education – and those results will require an intense focus on the substance of what the new technology can deliver, as much as on the process.

It takes time and money to create superior course materials. It also takes considerable faculty expertise – technical as well as scholarly. It will take time before the Internet is easily navigable, and before it holds a large enough store of rich material to rival our greatest research libraries.

But these things will happen, and as they do, education will be enriched. Meanwhile, I believe that universities have a special responsibility to exert real leadership in this sphere: not necessarily in the development of the technology itself, but in the imaginative and thoughtful uses of the best technology for the purposes of better teaching and learning.

We must be prepared to do now – over the course of the next ten to twenty years – what our predecessors achieved during the

New Technologies and Their Promise for Higher Education

late nineteenth century, when they made a conscious decision to create unrivaled university research libraries, new curricula, and new teaching methods. It can be done, and now is the time to begin.

+ + +

Is there a cautionary note on which to end? Certainly. Good data, new information, and excellent vehicles for communication are all critical to virtually everything that we do, in universities and in life. But they do not in themselves constitute the essential stuff of education.

All the information in the world will be of no avail unless we can use it intelligently and wisely. In the end, education is a fundamentally human process. It is a matter of values and significant action, not simply information or even knowledge. The Internet will not tell us what to do about individuals and societies that cannot afford to be on the Net. It will not tell us how to pay attention to those who are left out of the race – or who appear to have already lost the race. It will not show us – any more than our libraries full of books will show us – how to create a humane and just society. For this, we need – as we have always needed – human minds, human values, and human determination.

As we think in this conference about the implications of the Internet, not just for education but for the larger society, let us not forget what we mean by a “society”: what it is that we want to have an effect on – and what kind of an effect we want to have. It is how we address these questions – of purposes, of aspirations, of the consequences of our choices on real human lives, all lives – that will finally determine the effectiveness of our new technologies for education, and for people and communities around the world.