

How We Will Learn

Peter J. Denning
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Abstract: At the close of the 20th century, higher education is facing a series of strong, sometimes contradictory pressures which will transform the two major missions of the university, teaching and research. On the teaching side, these pressures will be resolved by a new distinction between knowledge and information, between “knowing how” and “knowing about”. This change will be accompanied by a strong alignment of graduate educational offerings with the needs and interests of working professionals, with a special emphasis on certifying competence in selected areas. This distinction will also foster a new commitment to offering broader perspectives that enable people to deal with complexity and uncertainty, act with wisdom, build powerful social relationships, and practice the skills of entrepreneurship. Digital media and Internet communications will transform learning practices from the sequential classroom curriculum to nonlinear hyperlearning environments. A new kind of teacher will emerge -- the teacher who is a course manager and a coach rather than an information transmitter. Private for-profit organizations will offer educational services, especially brokerage services, often in competition with the universities; some universities will disappear because they cannot adapt. On the research side, a new social contract will be struck among universities, business, and government. University research will take on new roles. The two most notable will be partnerships with companies in applied research, and research that leads to greater learning, to distinguishing the dross from the essential in all the information offered to us. Research will not wither for lack of funding, for universities will become entrepreneurial in finding sponsors. These new alignments will bring a new spirit of freedom and entrepreneurship that will kindle a Renaissance of higher education. The Renaissance will eventually spread to high school and secondary education.

Introduction

For education at the end of the 20th century, it is the best of times and it is the worst of times. More than ever, people are looking to education to help them overcome poverty, find good jobs, change careers, and live meaningful and fulfilling lives. They are becoming more consumer-oriented in their expectations of universities: they want university faculty to be familiar with the frontiers of knowledge, the state of the art, and the history of how things came to be as they are; faculty to be available to counsel and coach the students more than they do now; large lectures to be replaced by small classes; less bureaucracy; more assurance that graduates will be employed in good jobs; more practical skills; more attention to a broad education as citizens; and lower costs. These are an impossible set of conditions.

This paradox has been brought about by the explosive spread of information technology, which is changing people's practices of work and relationships and their expectations and hopes for education. The Internet and powerful PCs now provide many new opportunities for students to acquire information. The cable TV channel, the CDROM, and the modem are challenging the classroom, the book, and the library as their sole means to knowledge. Private businesses are beginning to offer for-profit educational services. Educational brokerages are offering on-line, interactive, multimedia courses built from modular resources intricately hyper-linked throughout the World Wide Web. Traditional schools, colleges, and universities are having enormous problems coping with the changes and have come under intense fire for their inability to change and for the declining performances of their graduates.

Most people see education as their key to jobs and a social position in a world dominated by technologies. The prospective student is looking to education to help deal with a mixed bag of anxieties. (a) The world seems overwhelmingly complex. Intercontinental communications have made the billions of other human co-inhabitants stunningly obvious. A hundred other countries regularly create problems or crises that affect us without warning. (b) Technological change is coming faster and with less warning. Not even the experts in the universities know about all the new technologies in advance; novices and experts alike learn of them from the newspapers. (c) There is too little time to deal with uncertainty and ambiguities. Business and career opportunities spring up without warning and demand action before they can be fully assessed. (d) No job is secure any more. Dozens of new professions are springing up and dozens of others are becoming obsolete. Your job may disappear and you may be too old for retraining. The lifetime of many new professions will be much shorter than a person's career. (e) In this soup, it is easy to fall into a mood of resignation, where you don't see much possibility for yourself. Our governments seem out of ideas and

money but still hungry for our thinner paychecks. We do not know where to stand as the winds of change howl across our society.

At the same time, business and government leaders, who look to the educational system to prepare and maintain their workforces, look to higher education to help them deal with their own anxieties. Prospective students are aware of these as well. (a) The number of small businesses is growing rapidly. Business leaders want employees who understand entrepreneurship and are comfortable with it. (b) Business leaders sense that business success depends ever more on the quality of networking --- meaning social networks facilitated by computer networks. (c) Customer satisfaction, loyalty, and adoption of products or services are essential for a business's success. Business leaders want employees whose actions inspire these assessments with customers and partners, and across cultural boundaries. (d) Business leaders have a growing sense that "information" does not lead to know-how. They want people working for them to understand the difference. They want employees of know-how. (e) Business leaders worry about the growth of their economy relative to others. They want employees who value hard work, loyalty, and perseverance.

In the above we can see two broad, seemingly contradictory forces. There is growing pressure for education to deliver more competence --- which in our current understanding of competence sounds like more specialization, more commercialization, more "training", and less education. In apparent apposition is the growing pressure for a general education that produces historical sensibility, wisdom, self-discipline, responsibility, and facility with relationships, citizenship, connections, and identities. This paradox cannot be characterized as a business versus traditional view of education. You will find prospective students, business leaders, and government officials holding to one side, or the other, or both.

We will certainly see some institutions divide in response to these pressures, splitting into a part that deals with general education and a part that deals with professional education. But I think the vast majority, driven by the traditional desire to integrate education and research, will change themselves into a new university that accommodates both these pressures without contradiction. When this happens, I expect a Renaissance in higher education. In what follows, I will examine the pressures in some detail and show why I believe this.

Universities in the 20th Century

In the past ninety years, higher education has moved from a concern of the family, church, and local community into a state-managed and state-run operation. The small classroom and personal involvement by parents and

teachers have given way to mass production of diploma-holders. Buoyed by a public mood that low-cost education should be available to all citizens, every state of the United States supports at least one large campus with student populations in excess of 20,000 -- larger than the home towns many of us grew up in. Most of the growth has occurred since 1960, when university budgets totalled about \$7 billion and students numbered nearly 3 million; in the mid 1990s, the budgets totalled about \$170 billion and students number over 13 million. In the US, state residents typically pay less than 40% of the cost of their education. Class sizes in required lower-division courses are often measured in the hundreds and in required upper-division courses in the many tens; fifty years ago, classes of one or two dozen were the norm. In many cases, the diploma is little more than a receipt for attending the prescribed classes and paying tuition.

Wilhelm von Humboldt, founder of the University of Berlin in 1809, did the most to spread the notion that universities are places of research. Their sole job had been to give students a broad education and to prepare them for careers in church or government. Humboldt argued that professors should be scholars and researchers as well as teachers. Over the next hundred years, Humboldt's idea spread to universities everywhere. The world over, universities became centers of scientific advancement and intellectual ferment.

During World War II, the US government offered large contracts to some universities to engage faculty and students in questions helpful to the war effort. The practice was institutionalized with the creation of the National Science Foundation in 1950 and the Advanced Research Projects Agency in the early 1960s. Based on a report in 1945 by Vannevar Bush of MIT called *Science, The Endless Frontier*, the legislation founding the NSF in effect established a social contract under which the government would pay scientists to engage in research of their own choosing on the understanding that significant benefits would come back to American society in the forms of military security, public health, and economic prosperity. In the 1980s, the objectives of federal support for university research were expanded to include international competitiveness, leading to the Human Genome Project, the Manufacturing Initiative, and the High Performance Computing and Communications Program. These new federal programs involve big monies; in 1993, for example, \$800 million were allocated to high performance computing, over half of which flowed to universities. After many years of generous government support for sponsored research, universities have made research a centerpiece of their public identities and offer faculty sure rewards for success at sponsored research.

The American university system has become the envy of the world. The ubiquitous, well-funded research programs are a major factor in this success. Many foreign students come with scholarships from their home countries, in

the expectation that they will help their home countries on their return. "Exporting" US higher education has become such a big business, that some economists believe it actually cancels much of the balance-of-payments deficit.

Something has happened to tarnish the image of research in universities. In the past half century, nearly every university has adopted the guideline of the American Association of University Professors that says each new faculty member must be tenured or dismissed in six years; in the context of the near-universal quest for a research reputation, this has produced among junior faculty a mass frenzy to publish papers, a habit they acquire for life. The problem is that much academic research is mediocre or of no consequence. About 2 million scholarly papers in science and engineering are published each year by 72,000 journals; the vast majority of these papers are read by a few hundred people at most; in most disciplines well over half the papers are never cited by another author. The "publish or perish" syndrome has devalued the original purpose of research in the university --- education --- and has even led the Federal government itself to question whether the massive spending on research produces the value claimed by the Humboldtian and Bushian adherents. The kinder critics say that publicly-supported research should be limited to the professors who are genuinely good at it. The sharper critics say that research should be banished from universities. Neither of these will happen; but there will be a major restructuring of the nature and role of research in education.

In the past thirty years, the universities have, largely at the behest of the state, undertaken new goals such as cultural diversity, ethnic studies, affirmative action, and economic competitiveness, all founded in the belief that the state can forge a better society with less racial tension, less disease, less poverty, less discrimination, and less unemployment. These goals are administered by special offices, sometimes with large staffs. The effect has been to add much to the bureaucracy and to diminish the relative effort spend on teaching.

Columbia University Professor Eli Noam has pointed out forcefully that the Internet and digital library are making the university library and local community of scholars obsolete, while at the same time, e-mail, phones, fax machines, and jet airliners have made it easier for faculty to establish stronger loyalties to national professions than to local institutions. Information technology therefore threatens the university as historically constituted and lays the foundation for the new university.

Business Designs

In his book, *Value Migration*, Adrian Slywotzky speaks of a "business design". He refers to the overall framework in which a business is

constituted --- its style, approach, and basic assumptions. Most businesses have research, development and marketing (RD&M) processes by which they invent and market new products and services. These processes are part of the company's business design. What happens if the business design itself becomes obsolete? Would that render the RD&M processes incapable of keeping the firm competitive? Indeed, this happens frequently, sometimes spectacularly! The designs of IBM and Digital Equipment Corporation worked very well for many years until Microsoft introduced commodity software --- and then Microsoft was challenged by the business designs of Netscape and Sun's Java. Maxwell House and Folgers coffees are now challenged by Starbucks. The Postal Service is challenged by FedEx and e-mail.

When a new company offers a better design, customers migrate to it. Because an older company's products and services are formulated within a context that the customers no longer find attractive, that company cannot seem to find products and services that will attract the customers back.

What happens if the institution with the obsolescent business design is a university? Private universities with obsolescent designs tend to respond quickly to declining enrollments. State-controlled universities are generally much slower. Customers of state universities who wish to migrate have two options: choose private alternatives (at a considerably higher price) or complain to the political process. After enough complaining, the political process responds by passing new laws to regulate the ailing schools, thereby freezing them more solidly in their current business designs, or by transferring budget monies to more popular programs.

Make no mistake about it, the market and political forces are conspiring to generate a new design for universities. The only questions are who's in, who's out, and who new is going to show up and compete for students? Today's universities are facing enormous threats not only to their traditional ways of doing business but in some cases to their very existence. At the same time, they are presented with enormous opportunities for significantly improved education that once again attains its aims of preparing people for productive careers and meaningful lives.

The Pressures to Change

The late 20th-century university features a structure of four-year programs, large classes organized on semester (or quarter) schedules, midterm and final examinations, a small menu of degrees awarded after a student completes a certain number of credit hours with certain grades, a substantial research program that is accessible mainly to graduate students, and occasionally a continuing education program adjunct to the main academic offerings. This

structure cannot accommodate the changes being forced upon the universities. For example, a graduate program leading to defined, certified competence doesn't fit because, with the possible exception of PhD dissertations, our conception of university doesn't accommodate courses of study in which students proceed at different rates toward a fixed outcome. Universities deal best with courses taking a fixed amount of time to produce variable outcomes.

The new expectations that students, parents, employers, and business executives have of universities are easy enough to see in their requests and complaints. These issues fall into three main categories.

(1) What we learn:

- Offer us a general education that affirms values central to our civilization, cultivates historical sensibility, facility in social relationships and social networking, and prepares us for responsible and meaningful careers, families, and lives.
- Accommodate those of us who are not fully prepared for the university curriculum by our high schools.
- Provide for those of us whose natural abilities can take us to much higher levels of performance than the average.
- Teach us about entrepreneurship in our respective fields.
- Teach us the wisdom we need to cope with the apparent rise of complexity in a world increasingly infused with technology.
- Offer us continuing professional education after the bachelor's degree.
- Offer us certification in certain professional fields, such as software engineers and network engineers.
- Offer us programs of study in hot interdisciplinary areas such as bioinformatics.

(2) How we learn:

- Give us new learning environments that accommodate differences in our learning styles, backgrounds, working schedules, and interests.
- Adopt course formats that fit with our working schedules.
- Teach us more through apprenticeships.
- Certify our capacity to act (i.e., practical competence) rather than our ability to regurgitate information.
- Incorporate privately-produced courseware, seminars and educational services to your offerings.
- Restructure the curriculum for Internet delivery without taking away our access to the faculty.
- Give us more content and worry less about process.
- Give us teachers who can motivate, manage, inspire, and coach us.

- Assess teachers by the results we students produce rather than by their individual classroom or research performances.

(3) The Social Contract for Research:

- Collaborate with industry on research leading to products.
- Involve undergraduates in research.
- Spend more time writing about your findings in ways we can understand and put to use.
- Teach us how to answer our questions when we are bombarded with information and cannot easily tell the dross from the essential.

The pressures for change in these areas are so intense that universities will change after huffing and puffing. They will restructure all the major components: general education, professional education including certification, the practices of learning, teaching, and research. As they do this, they will revise their interpretations of the nature of education, teaching, and research. The new interpretations will change the conventional wisdom and will resolve the paradoxes and contradictions that arise within conventional understandings. They are explored in the sections following.

There is no reason to suppose that all of today's universities will do these jobs. Some will transform themselves and be successful. Others will not. Some will disappear. Private organizations will be increasingly successful, and will probably take the lead in the educational brokerage business.

True Knowledge

A recurrent theme in these requests is the call for competence. Students and employers ask for educational programs that confer and then certify definite skills. Given that so many people now view a college diploma as a ticket to a good job, and that so many employers recruit directly from universities, this is no surprise. Yet it inspires many howls from faculty who hear the word "competence" as a codeword for vocational "training" and who argue strenuously that it is not the mission of a university to provide training. They view course aimed at skills as steps in the direction of increasing specialization, an affront to the university's mission of general education.

Educators do not agree among themselves on this. There are many who argue just as strenuously for more proficiency-based courses, which means that students don't pass until they can *demonstrate* that they know the material and can act effectively with it. To reassure their colleagues, these educators say they mean competence in a broad sense that ranges from operating a computer or building a large software system to public speaking, rhetoric and debate, critical thinking, analyzing history, working on and

managing teams, and leading a group. The common theme is that competence in a field includes knowledge of its history, methods, goals, boundaries, current problems, relations to other fields, and an ability to meet or surpass standards defined by those already in the field. Certification is another name for the public demonstration of competence. In some cases, such as engineering, education, accounting, law or medicine, certification can be quite specific and rigorous. Certificates are necessary or at least highly desirable for professional practice.

I think that this debate is the first sign of an important change in our understandings of data, information, and knowledge. It is seeping into more people's consciousness that there are fundamental distinctions among these three, which may be described as follows. (1) Data are symbols inscribed by human hands or by instruments. (2) Information is the judgment, by an individual or group, that given data resolve questions, disclose or reveal distinctions, or enable new action. In other words, information is data that makes a difference to someone. Information thus exists in the eyes of the beholder; the same data can be nonsense to one person and gold to another. (3) Knowledge is the capacity for effective action in a domain of human actions.

Lewis Perelman likens these distinctions to a menu in a restaurant. The data are the symbols on the menu; information is the understanding of the restaurant's offers; knowledge is the dinner. You don't go to the restaurant to lick the ink or eat the menu.

These distinctions are not practiced rigorously in the university. Most curricula are set up on the assumption that there is a body of knowledge (organized data about a field that conveys information to its beholders) that must be transmitted to the students. The teacher is the communication channel. Testing reveals whether the information survived transit intact. Universities are serving mostly menus. The call for competence is a cry from the hungry for dinner.

As we begin to heed this call, we will become increasingly aware of two kinds of knowledge. One is practical knowledge, the skills behind action. Over time with practice and coaching, one's skill level will increase. There are six distinguishable levels: beginner, rookie, professional, expert, virtuoso, and master. Each level has its own standards for performance set by the practicing members of the domain. It can take years to advance to the higher levels. Apprenticeship is the most effective method of learning skills.

The other kind of knowledge is awareness of the observer one is. Each of us is filled with interpretations and biases that affect what we perceive. There are many things we cannot see --- and we cannot see that we cannot see them. Thus the observer I am affects my ability to act in a specific situation because it

affects my power to make distinctions and connections. Each of us has experienced moments when our observer shifted and new actions appeared to us. We call these paradigm shifts, Aha insights, eureka moments, and sudden realizations. Unlike skill acquisition, shifts of observer can happen suddenly and can affect performance immediately. Master-teachers and coaches know this: they can help the student-apprentice acquire skills and judgment faster by assessing and shifting the student's observer.

Although observing another person's observer is hard enough, observing one's own observer can be nearly impossible. This is why changing a community's paradigm -- for example, a business design -- is so difficult. Most people are not aware of how they see the world and are not open to the possibility that they are blind to the very possibilities that would solve their problems. It is the special skill of leadership that helps communities of people break out of their current blindness.

The growing awareness of these distinctions will engender significant shifts in education. The student-teacher relation of "apprentice-master" will become the most traveled path to knowledge. The teacher will need special skills, not at presenting information, but at observing and shifting how students see their world. The apparent contradiction between general and professional education will disappear. General education seeks to produce an observer who can act effectively by reading, writing, speaking, and listening, and who understands history, literature, philosophy, language, and social relationships. General education is the context in which a person can attain higher levels of competence. Universities can offer professional people refreshers for their general education as well focused certificate programs.

Hyperlearning

In *School's Out* Lewis Perelman vividly pictured the changes ahead for education in the presence of the forces enumerated above. He says that the resistance of current schools to make changes resembles the opposition of equestrian associations in the late nineteenth century to the arrival of the "horseless carriage", or of candle and gas associations to the arrival of the electric lamp. Automobiles eventually swept away the horse-drawn carriage, electricity the gas light. Perelman says that future historians will record that the school reform movements of the late 20th century were as irrelevant to the new world of education as horse reforms were to the automobile: the learning revolution has already made the classroom teacher as obsolete as the blacksmith. He gives the name *hyperlearning* to the new kind of learning environment that is emerging. The prefix "hyper" here means non-linear and multi-dimensional, as in a mathematician's hyperspace or an author's hypertext.

In the traditional model of school, a course is a sequence of topics covered in a series of lectures, held in classrooms at weekly intervals, with homework practice in between. This is a linear model of learning. It is designed to convey information in an orderly manner. All students proceed at the same pace regardless of their interests, prior experience, talents, or other demands on their time. At the end, grades indicate the levels of achievement they were able to make in the fixed time period allocated for the course.

Imagine a new model. Instead of a classroom, see in your mind a large “learning room” with an entrance, an exit, and a number of learning stations (booths). You meet the teacher on entry. The teacher may organize you and other students into a small group that works together while you learn. The room’s exit is guarded by a “certifier”, whose job is to assess whether you have become competent at everything promised by the teacher, according to well-defined standards. You visit the stations to learn particular subjects or practices. Colored lines on the floor suggest paths among the stations. You can visit as many stations as you need, and in any order consistent with your current knowledge, to prepare yourself for final certification. You can take trial certifications and then backtrack to the stations needed. You can take self-assessment tests at any time you like. You collaborate with other students in projects and study groups. You call on the teacher for help at any moment you are stuck. The teacher will offer guidance if you are heading in a wrong direction. In contrast to the linear model, everyone who exits gets the same “grade” (a certificate of completion or competence); the variables are the length of time and the path followed. While this image may not be the final hyperlearning model, it is a useful way to visualize the first kinds of hyperlearning environments that are now emerging.

It might seem that this paradigm makes all students be the same and does not leave room for talented or gifted students to develop their skills. This is not so. In fact, the talented student will complete a hyperlearning room faster than the others and go on to achieve more advanced certifications than the others.

An important technology in this picture is the certifier, which is a teacher-assisting agent that confirms when a student has met the learning objectives of a course and issues an authoritative declaration. The first generation of certifiers already exist and are not very powerful; they offer multiple-choice and short-answer tests for problems with algorithmically computable answers, such as occur in math, science, and engineering. Future generations of certifiers are likely to include intelligent agents, virtual-reality simulations, or interactive conferences with a panel of judges who can question and direct the candidate through a series of actions. The same technology can also be used to support self-assessment tests by which a student can tell how well prepared he is to enter a learning environment or to be certified. Eventually, we will get very good at designing hyperlearning

environments that will prepare a person for practice in a profession or specialty.

Professional Education

College curricula are organized for the undergraduate who comes straight from high school and earns a bachelor's degree in four years. The Master's Program covers two more years beyond that. Universities offer very few programs for the remaining 45 years of a person's professional life. Most continuing education programs are not part of the regular academic program and are not staffed by the regular faculty.

A growing number of working professionals want certification in selected subjects valuable to them (and their employers) in the workplace. They want educational programs that promise and deliver specific, well-defined competence and skills. They want an evolving and growing portfolio of professional certificates. They do not want these programs to be isolated, but rather conducted in a framework that affirms and reinforces the basic disciplines of a general education. The desire for professional certificates will grow into a market force so powerful that it might supersede the formal graduate degree with an equivalent set of certificates.

Two kinds of education programs will meet these demands. One is a program that leads its students to certified competence in an area. Such programs might take a typical student a year to complete. The other is a program that offers to change a student's observer. Examples include a study of a timely question (e.g., "how can a business reduce cycle time to delivery of new products?"), a refresher of some aspect of general education (e.g., "how does linguistic philosophy inform us in the knowledge age?"), or an introduction to a field (e.g., "security and privacy in networks"). Such programs might take a few days to a few months to complete.

Some universities now have certificate programs, which normally award the certificate to a student who has completed a specified set of courses with A or B grades. These certificate programs do not meet the demand described above. Professional certificate programs will promise specific competence and skills, include rigorous project work and testing, and will take as long as needed to deliver a given level of competence to those willing to persevere. Developing these programs and making them a regular part of the university's offerings will be a major challenge because they are based on a variable length of time to attain a given grade (the certificate) rather than a fixed length of time leading to a variable grade.

Professional education will be offered in new course formats consistent with the working schedules of employed people. They will feature occasional

workshops, active working groups of students communicating via the Internet, projects, and public exhibitions and defenses of results. The regular weekly scheduled class will become a little-used option.

With a focus on competence and a clientele of working professionals, it will become possible to design educational programs offering higher levels of competence than we are able to offer now. These include the expert, virtuoso and master levels, which we normally associate with later stages of a person's career. This will be fertile, virgin territory for universities.

The New Teacher

The same pressures impelling us toward new curricula will compel a revolution in teaching. Our practices of teaching will change to fit the new university, its curricula, and its hyperlearning approaches. Two forces are driving this. One is the demand of students for a more customer-oriented relationship with the university. Faculty are going to master new skills in listening, trustworthiness, compassion, service, valuing diversity, communication, and historical sensibility --- not only to interact effectively with their future students, but to teach these things to them.

The other driving force is digital media and networking. Faculty have been brought up in an environment where most teaching is presentation and testing. Teaching can be assessed by peer review -- faculty can observe each other's performances in front of the classroom. As classrooms disappear and machines take over much of the presentations --- often doing it much better than a live human lecturer --- and as the machines take over testing and record-keeping, what will be left for the teacher to do?

I said earlier that the job of a teacher is to cultivate knowledge. This job can be elaborated in terms of the metaphor of the clearing --- the space of actions available to a community of people. The metaphor recalls an opening in the forest; within it, movement is easy, but outside it movement is restricted by the underbrush. One aspect of a human clearing is its common sense --- the shared beliefs and practices of its people. To move effectively in the clearing, the new person must learn those practices and be able to perform them effortlessly, without little or no thought. He must adopt and become part of the common sense. The person who defies the common sense can quickly become ensnared in the underbrush of resistance; he will be slowed down or, if others consider him a threat, will be put completely out of commission. The job of the teacher consists of three main aspects.

1. Sharpening the student's awareness of the common sense of the clearing into which the student seeks entry.

2. Showing the students what the framework of practices of the clearing is; this includes an historical account of how and why that framework came to be, its methods and practices, its goals, its boundaries, its current problems, and its relationships to other clearings.
3. Provide coaching and exercises that assist the student learn to observe the clearing and engage successfully with its practices, so that these powers of observation and capacities for action become ingrained and skillful.

It should be obvious that teaching is not made obsolete by technologies for presentation, assessment, and record-keeping. To the contrary, the teacher will be expected to inspire, motivate, manage, and coach students. Few teachers have learned these skills because they never had to and in any case there was no one to teach them. New and extensive development programs will assist them in learning how to be highly effective teachers. The topics that will be important in such a program include:

- Educational goals
- Data, information, and knowledge
- The role of educational technology
- How humans use language for disclosure, coordination, and information
- Clearings
- Reading
- Communication
- Listening
- Seduction
- Trust
- Compassion
- Fear and self-esteem
- Service
- Assessment
- Diversity
- Seriousness and humor
- Invention and innovation
- Historical sensibility
- Games and simulations
- New course management practices
- Coaching
- Designing exercises to help students observe and learn well

Unfortunately a good training workshop in the above topics is not enough. Teaching practices are strongly connected with the curriculum. There is little room for some of these practices in today's curricula. Engineering curricula, for example, are structured as an intense presentation of topics in a well defined order; the use of games and simulations or creation of milestones

that can be passed only by proficiency demonstrations would not fit easily into this structure.

The two driving forces of customer-orientation and machine-aided presentation are moving us inexorably toward restructuring our curricula and teaching practices. The only unknown is the timing.

The prospect of this change is undoubtedly unsettling to many faculty. Many will be offended by a move to treat students as customers who expect them to fulfill educational promises rigorously. Moreover, the end of presentation-oriented teaching will bring new methods of assessing teaching effectiveness. The situation will be a lot like that faced by the manager of a business project or the manager of a ball team. The manager's performance will be based on the performance of the team. Teachers will be assessed by how well their students perform. Nothing else will matter.

The New Social Contract for Research

I mentioned earlier that the 50-year-old social contract about research has come to an end. What will replace it? Even as a German university gave birth to the modern research university, a German research institute may have discovered a formula for research in the 21st century. Writing elsewhere in this volume, Dennis Tsichritzis, the Chairman of GMD has proposed that the ultimate value of research lies not in the discovery of ideas but in the innovations that eventually result. An innovation is a shift in the standard practices of a community that makes the people more effective at what they do. A product is most likely to stimulate innovations when it is a tool by which the customer can make his own innovations. The modern research university is hampered by a belief that the discovery of new ideas is the main path to innovation. The process of idea-discovery is actually one of four different processes that produce innovations. The research associated with each process is based on values and emphases peculiar to the process. The four processes are:

1. **Generating new ideas.** Powerful new ideas shift the discourse, in turn shifting the actions of those practicing the discourse. Research consists of formulating and validating the new ideas. It places a great deal of emphasis on originality and novelty. The scientific publication process aims to certify originality and novelty through peer review.
2. **Generating new practices.** A teacher inculcates people into the practices of a new discourse. Research consists of selecting, clarifying and integrating the principles relevant to the practice. It places a great deal of emphasis on understanding that produces competence.

3. Generating new products. New tools enable the new practices, producing an innovation; the most successful are those that enable people to produce innovations in their own personal environments. Research consists of evaluating and testing alternative ways of building a tool or defining its function. It places a great deal of emphasis on economic advantage.
4. Generating new business. Successful firms continually improve their business designs. Research consists of testing markets, listening to customers, and developing new narratives about people's roles and identities in the world. It places a great deal of emphasis on market identity and position.

It is interesting that although Tschritzis does not mention the fourth kind of innovation, he clearly practices it his leadership of GMD.

The first two kinds of research are done primarily in universities, the last two primarily in companies. The third kind is most common in industry R&D and is occasionally encountered in university-industry collaborations. Most innovations familiar to the public have come directly from the third kind of research and only indirectly from the first.

The second kind of research is often overlooked or downplayed, yet it plays an extraordinarily important role in developing individual and corporate competencies. Many faculty are highly competent practitioners of the second kind of research. Through their scholarly work they investigate questions, compile results, integrate their findings, bring clarity to a subject, and offer the new narratives needed for others to understand the subject. They produce popular articles, books, simulators, tools, and software. By participating in the research process, writing scholarly papers, building software, and attending conferences, the faculty member stays sharp, teaches students competent investigative practices, and maintains credibility as a person knowledgeable about the leading edges of technology.

As time goes on, the first kind of research will be performed only by the creative thinkers, mavericks, off-beat inventors, trouble-makers, and those with a talent for finding answers to basic questions --- i.e., the people who are genuinely good at it, working mostly in well-equipped labs. This will be the only way to adapt to shrinking federal funding for basic, "curiosity-driven" research. The second kind of research will rise in stature because it will be directly tied to the educational mission of the new university. The third kind will become more popular as universities come to grips with their own entrepreneurialism, discovering that they can realize income by helping businesses with their directed R&D, and discovering that this kind of research attracts students.

Although I believe that university research will be restructured, enriched, and broadened in its interpretation, I do not believe it will be eliminated. The research mission is too deeply ingrained into the university's psyche.

The New University

Although information technology, networking, and digital media may be undermining the basic assumptions behind our universities, we can look to the movements of the marketplace and political processes for guidance on how to respond to the changes. These are precisely the forces exerting the greatest pressures. I have sought here to discuss these forces and suggest the great opportunities presented to the universities who respond.

The teaching function of the university is being reshaped by new expectations from students concerned about the return on their investment in education, from business leaders seeking graduates with practical competence, and from politicians who want more efficient and effective education for the state's subsidies; and by new technologies and competition from private firms. The traditional linear classroom will give way to hyperlearning environments. Professional training and certification will become a new and lucrative line of business in graduate education. Curricula will be restructured to account for new understandings of the distinctions between knowledge and information. And a new kind of teacher will emerge, who is good at inspiring, motivating, managing and coaching, and who is evaluated on the performance of their students.

The research function of the university will be reshaped around a new social contract that places more emphasis on research leading to competence and on research partnerships with companies. (The latter, it should be noted, will be bolstered by industry's disinvestment in its own research.) Research will be funded less by the federal government and more by the university's own entrepreneurial actions.

Those who do respond will be rewarded with enriched educational programs, more competent graduates, satisfied employers, an enlarged repertoire of ways to engage in research, programs in professional education, and new teaching practices. Education has a bright future indeed.

READINGS

In *School's Out* (Avon Books 1992), Lewis Perelman discusses in great detail his vision of the future of education, a paradigm he calls hyperlearning. Definitely read this. If you like the traditions of the university, you are likely to find this book deeply disturbing. Perelman comments on his philosophy

of knowledge and learning in an interview published in the on-line *Journal of Bionomics*, September 1996 (<http://www.bionomics.org>).

In *Value Migration* (Harvard Business School Press 1995) Adrian Slywotzky discusses at great length the concept of business design and gives many examples of customers migrating to new business designs that offer them greater value.

In *Post Capitalist Society* (Harper Business 1993), Peter Drucker lays out a vision of what teaching and learning for the knowledge worker will entail. This expands on an earlier version of his vision in *The New Realities* (Harper & Row 1989). Drucker's works often give readers a sense of understanding and serenity in the face of complexity because he is so good at revealing the historical forces always at work and showing their implications.

Beginning with Charles Sykes's *ProfScam* (St Martin's Press 1988), various authors have written best-selling, iconoclastic books about disease and corruption in the academy. Even if you don't accept the premises of these books, they were best sellers and hundreds of thousands of people paid \$24.95 to own one or more of them. If nothing else, they give good insight into what ails the current business design of universities.

Not normally given to comments on university research, *The Economist* (24 August 1996, page 14), said that the "publish or perish" syndrome is devaluing education by taking faculty energy away from teaching. Much of what faculty have accomplished is mediocre.

Eli Noam gave his views on the demise of the university in a commentary for *Science* magazine in October 1995 and again for *Educom Review* in May/June 1996. He spoke specifically about the way information technology is undermining the traditional assumptions of the university.

Elliott Soloway has written repeatedly about the need for effective teaching and teacher development, most recently in "Teachers are the key" in *Communications of ACM*, June 1996.

Andy Whinston and two colleagues have written about educational brokerages in "Electronic markets for learning: education brokerages and the Internet", *Communications of ACM*, June 1996.

I have written several articles exploring some of these themes. You can find them in the *Communications of ACM*: (1) "Educating a new engineer," December 1992; (2) "Designing new principles to sustain research in our universities," July 1993; and (3) "The university's next challenges," May 1996. See also "Business Designs for the New University" in *Educom Review*, November 1996.

With Daniel Menascé I have produced prototype hyperlearning environments in the Center for the New Engineer (<http://cne.gmu.edu>). The CNE maintains a library of learning modules and workbenches; the math and statistics refresher modules contain prototype certifiers.