

Medical Education

Introduction

First, let me compliment you on these retreats that pull together people from across the Medical Center to focus on key strategic issues...

Let me also compliment you on devoting this particular retreat to medical education... since while the rapidly changing nature of health care delivery and research tend to dominate the agendas of most medical centers, your primary responsibility is that of producing the physicians of tomorrow through your instructional programs...

Why me?

I must admit, however, I was a bit puzzled as to why you would invite me to make a few comments about medical education.

Generally I am simply invited over to "show the flag"... to give one of my all too standard talks...

But George indicated that he really did want me to focus on medical education for a few minutes...

A couple of ties...

i) Of course, I do have an M-1 in the family... so I find I am learning about medical education from the underside...exciting discussions of gross anatomy lab over dinner...etc...

ii) But there is another possible connection... I, too, was educated in what might be called a knowledge-intensive profession...science and engineering...one that is experiencing the enormous pressures of a veritable explosion in the knowledge base...

And it is from this latter viewpoint that I feel it most appropriate to make several observations...

Themes of the Future

In my remarks over the past several months I have observed The students we are educating today will spend most of their lives in the next century...they will be citizens of the 21st Century...

Yet we, their educators, are very much products of the 20th Century...

And our institution, the university of today, is in reality a product of the 19th Century!

The way we are organized into departments and colleges...our sequential approach to education... even the concept of courses and credit hours... all were introduced over a century ago.

It is therefore both appropriate and important to ask the question:

Is the University as we know it today really prepared to educate the citizens and serve the society of the 21st Century?

While it is always dangerous to attempt to predict the future, three themes seem likely to dominate:

i) It will be a future in which our nation becomes a truly multicultural society, with a racial and ethnic diversity that will be extraordinary in our history...

ii) It will be a future in which The United States will become "internationalized"... in which every one of our activities must be viewed within the broader context of an interdependent global community... as we become a "world nation", with ethnic ties to every part of the globe...

iii) It will be a future in which we rapidly evolve from a resource- and labor-intensive society to a knowledge-intensive society, in which intellectual capital...educated people and their ideas...become the keys to our prosperity, security, and social well-being.

I believe that these three themes, the themes of pluralism, the internationalization of America, and the ever-increasing knowledge-dependence of our society are just as important for medical education as for any other part of the university...

i) Demographic diversity will characterize both those delivering health care and those receiving it. Hence, the Medical School has a special responsibility to recruiting and nurturing in their programs students from a diverse array of racial and ethnic backgrounds, reflecting the pluralism in American society. I believe that recruiting and retaining such students--making Medical School accessible to them in the first place... then creating an environment in which they can thrive... will require reassessment and change in the structures and practices that characterize medical education.

So too, training medical students to effectively and sensitively practice medicine on a population needing care (increasingly numbers of elderly and of racial and ethnic minorities) is likely to require yet other changes in the way that medical care and education are conceived and approached.

Internationalization may mean increased attention to and convergence of health care practices and systems across national boundaries. This clearly has implications for research collaboration and for the dissemination of research findings that can affect clinical care.

But perhaps the increasingly knowledge-intensive nature of our society will demand the most profound changes of all in medical education and practice.

Change and Renewal

The Challenge

The capacity for intellectual change and renewal has become increasingly important to academic institutions.

New ideas and concepts are exploding forth at ever increasing rates...

In many fields, the knowledge base is doubling every few years...

In such fields we have ceased to accept that there is any coherent or unique core of wisdom that serves as the basis for new knowledge...

We've seen simply too many instances in which a new concept has blown apart our traditional views of a field...

the theory of relativity
quantum mechanics
the molecular foundations of life...

We are increasingly surrounded by radical critiques of fundamental premises and scholarship...

Profound, new ways to approach knowledge...

As the pace of the creation of new knowledge accelerates, it seems apparent that we are entering a period in which permanence and stability become less valued than flexibility and creativity... in which the only certainty will be the presence of continual change...

and the capacity to relish, stimulate, and manage change will be one of the most important abilities of all.

Traditional Approaches

Part of the problem is that most of us have been trained to think in terms of change as a linear, causal, and rational process. We have been taught that by looking at the past, we can extrapolate into the future.

Yet, perhaps because of my background as a physicist, I have become increasingly convinced that change in most complex systems, organizations, or fields of knowledge is:

- i) highly nonlinear
- ii) frequently discontinuous
- iii) and usually stochastic...random in nature...

Let me expand on this theme for a moment...

A Modern View of Change

We now know that most complex systems that may first appear to be stable and unchanging are, in reality, comprised of components that are continually fluctuating or changing... In these systems, a situation sometimes occurs in which a single fluctuation becomes so large, as a result of feedback and nonlinearities, that it shatters the stability of the system. At this singular point, called in the language of physics, a bifurcation point, it becomes quite impossible to predict in advance which direction change will take...

...whether the system will disintegrate into a highly disordered or chaotic state...

...or leap to a new higher level of order or organization...

Of course, such bifurcation instabilities cannot be triggered by just any old fluctuation, but only by those that are particularly "dangerous"--that is, those that can exploit to their advantage the nonlinear relations that can trigger the instability of the existing state.

The more complex a system is, the more numerous are the types of fluctuations that threaten its stability.

Revolutionary Change (a la Kuhn)

If we take the viewpoint that most organizations...or even most fields of knowledge...are examples of such complex systems, then this view of change is remarkably similar to that of Thomas Kuhn's thesis concerning the way that knowledge changes in a field.

In essence, it says that a single individual...or idea...can create dramatic change...a revolution, if you will, in the traditional way that we look at a field.

Kuhn's uses the term "paradigm" to refer to the body of knowledge...in essence, the way that one is accustomed to look at a field...accepted practices or perspectives.

In a sense, a paradigm is what the members of a community of scholars share, and conversely, a scholarly community consists of people who share a paradigm.

However, in contrast with the standard useage, a knowledge paradigm is not really a model designed for replication; rather it is an subject for further study and articulation.

Most research consists not of seeking major novelties, but rather polishing up existing paradigms...essentially mopping up -- or in the language of the familiar GM add, "sweating the details"...

In Kuhn's view, major progress does not occur through the gradual evolution of an existing paradigm, but rather through a revolutionary process in which an existing

paradigm is replaced by a new paradigm.

The transformations of paradigms are revolutionary in nature, and the successive transition from one paradigm to another via revolution is the usual developmental pattern of mature field of knowledge.

Kuhn also observes that those who achieve the fundamental inventions of a new paradigm are usually either very young or very new to the field whose paradigm they change. These are the individuals who, being little committed by prior practice to the traditional rules of the field, are particularly likely to see that those rules no longer define a playable game and to conceive another set that can replace them.

They can make contributions of unusual importance since they haven't had the time yet to fall in the same old ruts that have trapped more experienced scholars.

An aside here: This may be one of the reasons why the perspectives of feminists, minorities, and third world scholars are of such importance to us...why they can lend a rich new vitality to our traditional forms of scholarship -- why they can launch new paradigms of learning...

Note that just as in my earlier discussion of the nonlinear evolution of complex systems, we again see a theme in which single fluctuations...individuals or ideas...can trigger dramatic...and possibly unpredictable...change.

How do we respond?

If our future is indeed one in which the capacity to stimulate and manage intellectual change becomes important...

And in which change is also viewed as a highly nonlinear, occasionally dramatic, and usually unpredictable process triggered by extraordinary people and their ideas...

Then, this suggests that academic institutions may well wish to think carefully about how they go about their business of teaching and research...

In this future, renewal and change will become essential for both the achievement and sustaining of excellence.

It seems critical that academic institutions not just respond grudgingly to change;
A university must relish and stimulate and manage a process of continual change and renewal if it is to achieve excellence and leadership.

The Analogy with Engineering Education...

Let me apply this to the evolution of my own profession... engineering...which has been buffeted by radical changes in the intellectual nature of its activities...

Indeed, we now find ourselves telling our students that even during the years of their education, most of what they learn may well become obsolete...hence they must view themselves as simply taking the first of many steps down the road of a lifetime of education.

Prehistoric Times

In the early days, engineering was an art...a craft...

It was passed down from generation to generation by the well-worn process of apprenticeship... in with the master craftsman taught through practice the tools of the trade...

The Old Days: The birth of a profession

As the craft of engineering became more standardized... and the need for engineers more intense, roughly a century ago major universities responded by forming

schools of engineering to train these professions. These schools, while part of broad universities such as Michigan, were largely self-contained, teaching all of the topics felt to be necessary for the engineer... including writing and speaking skills, languages, and even humanities!

Recent Times: The birth of a science

As the pace of engineering knowledge began to accelerate, the traditional methods of engineering education...rather engineering training...lost their capacity to keep up with the explosion in the knowledge base.

Perhaps the key event in this was the strong involvement of scientists...physicists, chemists, mathematicians...in the WWII war effort in what were essentially massive engineering projects... the Manhattan Project...the development of radar, the computer, and so on...

Hence, it became apparent that a radical shift was necessary in the nature of engineering education as it became ever-more heavily science dependent.

Thus, the 1950s, 1960s, 1970s saw the development of engineering as essentially a science...with most of an engineering education evolving rapidly away from specific skills to basic scientific foundations...

Here the idea was to provide a foundation on which an engineer could develop the capacity to learn throughout a lifetime...to continually acquire new knowledge...and to adapt to the rapidly changing knowledge base.

However there were some very interesting negative side effects to this approach:

- i) First, the very fundamental scientific nature of engineering education yielded graduates with little specific knowledge...hence it was common for industry to complain that the universities were not being responsive to their needs, since they were not turning out graduates who could be productive immediately...
- ii) Second, both engineering education and practice became more and more specialized...both in a disciplinary sense, with the early specialties such as civil, mechanical, chemical, and electrical engineering evolving into dozens of new specialties such as aerospace, nuclear, computer, systems, marine, agricultural, industrial engineering and so on... and in function...with research engineers, development engineers, design engineers, production engineers, sales engineers...

The Challenge of Today: Creativity.

Today, we find engineering education and practice undergoing yet another profound change...one that I fear very few people--including the educators--realize.

It is being driven by technology itself...and particularly that marvelous symbol of our brave, new world... the computer.

If you think about it for a moment, you realize that the computer is, in reality, a "lever for the mind".

It not only relieves one from time-consuming, routine drudgery, but it furthermore increases ones

intellectual span.

Ten years ago, the manufacture of a new product would require a team of engineers...
...the development engineer would dream up the general ideas
...the design engineer would develop the detailed design
...the analysis engineers would determine the mechanical, thermal, and structural characteristics
...the production engineer would design a manufacturing process...
and so on.

Today, all of this can be accomplished by one individual, sitting down at a computer workstation, working with modern computer-based design tools (frequently assisted by artificial intelligence interfaces), flexible manufacturing cells, and so forth.

Hence, what has happened is that technology itself has converted the engineer back from a specialist to a generalist...allowing him once again to span the entire sequence of activities from the birth of a new idea to its realization in practice!

Further, in contrast to the past in which 90% of an engineer's activity was taken up in exhaustive analysis of a particular design...today the computer takes over this task freeing the engineer to focus on creating the design itself...

In a sense, the computer is rapidly shifting the focus of engineering practice back from the right to the left side of the brain...away from the analytic and back to the creative...

In a very real sense, the computer has taken engineering full circle back to an "art form"...radically changing the profession to once in which creativity has become the most valuable trait of all!

You can imagine the extraordinary impact this is likely to have on engineering education!

How in the hell to do you TEACH creativity?

It is no surprise that my colleagues are increasingly interacting with artists, musicians, and architects... the other creative disciplines...as well as psychologists... to better learn how to modify their own profession.

Back to Medical Education

Of course, there are many similarities here to the changing nature of medical practice and training...
There has been an explosion in the knowledge base...
exciting new technologies...
PETS, lithotripters, free-electron lasers...
exciting new approaches...
molecular medicine
the shift from treatment to prevention...
from illness to wellness...
Changes driven in part by the manner in which health care is financed...
HMOs, PPOs, and all of the rest of the alphabet soup of organizational structures of modern health care
Changes driven by the changing nature of American society...
the graying of America, as our population ages...
dealing with the staggering problems of providing adequate health care to the poor of this nation
And, of course, changes we face the challenges of

serving this highly pluralistic, knowledge-intensive, world nation that will be America of the 21st Century.
How does one prepare a student to enter the turbulent world of modern medicine?

Perhaps there is much to be learned from the evolution of other professions such as engineering and law which long ago became so swamped by the knowledge base that they were forced to dramatically change their pedagogical methods...

A couple of pieces of advice...

But it seems most inappropriate for a bureaucrat such as a university president to offer advice on how to restructure your curriculum to respond to these challenges...

Although, to be sure, I am deeply committed to working with you to support these efforts.

Rather, let me simply conclude my remarks with two observations that I passed on to your graduating class last spring...

1. While it is true that your graduates will face careers characterized by change and uncertainty, increasingly dominated by technology and financial considerations, it is also the case that your profession is distinguished by its concern for people...

medicine is indeed the caring profession...and it must always keep this as its central theme...

Indeed, as I was browsing through the NYT a week ago, I ran across an article on the recently report by the New York Academy of Medicine which suggested that: "The nation's medical schools are preparing doctors for medicine of the past. That instead we should focus more on the human nature of medicine...on the doctor-patient relationship..."

2. Second, whenever I give a commencement address these days, I generally highlight my remarks on the importance of liberal learning with a haunting quote from

T. S. Eliot's poem, The Rock:

""Where is the Life we have lost in living?"

"Where is the wisdom we have lost in knowledge?"

"Where is the knowledge we have lost in information?"

But it seems appropriate that on this occasion, I quote the entire passage...

"All our knowledge brings us nearer to our ignorance..."

"All our ignorance brings us nearer to death..."

"But nearness to death no nearer to God."

""Where is the Life we have lost in living?"

"Where is the wisdom we have lost in knowledge?"

"Where is the knowledge we have lost in information?"

The cycles of Heaven in twenty centuries

Bring us farther from God and nearer to the Dust."

While one typically views education and training as extracting knowledge from the vast information characterizing modern medical practice, let me suggest that the real goal of this education must be something far beyond this.

Our goal must be one of liberal learning...

of helping our students to extract wisdom from knowledge...and through that wisdom, preparing them to learn the art of life itself...