Teaching “vs.” Research
1. Introduction
   1.1. For much of their history, America’s universities were protected enclaves respected well enough but mostly unnoticed and allowed to go about their business unchallenged and largely unfettered.
   1.2. What a contrast today, when the university finds itself considered a key social economic, political, social and cultural institution.
   1.3. And we are rapidly evolving into a new post-industrial society, in which the key strategic resource necessary for prosperity and social well-being has become knowledge itself.
   1.4. Indeed, we are entering what might be called an “Age of Knowledge” in which educated people and their ideas will play the role that in the past were played by natural resources or geographical location or labor pools...
   1.5. In all advanced societies, our future depends on an ever increasing extent on new discoveries, expert knowledge, and highly trained people. Like it or not, universities are our principal source of all three ingredients. (Bok)
   1.6. In the pluralistic, knowledge-intensive, global future that is our destiny, it is clear that the quality of and access to
       ...education in general
       ...higher education in particular
       ...and great research universities such as the University of Michigan and its sister institutions most specifically of all...
       are rapidly becoming the key factors in determining the strength and prosperity of our state.
   1.7. But, ironically enough, our increasingly critical role has not brought with it increased prestige, public confidence or respect.
   1.8. Instead, like so many other institutions in our society we are roundly criticized by right, left and center and from even from within by many faculty, students and staff for flaws large and small, fundamental and trivial.

2. Concerns
   2.1. Concerns from Outside the Academy
       The critics
       Perhaps goaded on by criticisms from the right--Allan Bloom and William Bennett, or the criticisms from the left for new styles of learning based on nonwestern cultures and new forms of thought such as feminism, liberation theology, and or other forms of “politically correct” thinking.
       The titles of the books by some of our critics reveal this:
       ...“The Moral Collapse of the University”
       ...“Tenured Radicals”
       ...“Killing the Spirit”
       ...“Profscam”
       ...and, yes, Virginia, “The Closing of the American Mind”
       The American research university is under serious stress...demographic changes will affect the number and profile of students...a generation of faculty will retire in the ‘90s, and the
replacement pool is too small in many fields.
...they are criticized by governors for financial profligacy
...attacked by parents and students for uncontrolled
escalation of tuition
...investigated by the Department of Justice for
collusion in tuition and financial aid fixing
...criticized by both Washington and their own faculties
for rising indirect costs
...attacked by Congress for alleged conflicts of
interest or providing easy access of foreign firms
to government-supported research
...attacked by legislatures for the tenure system,
...and attack by the left and the right for the quality
of undergraduate education.

Examples of the rhetoric
“Higher education is underaccountable and underproductive...
in a sickening tailspin...a national disgrace.”
“Undergraduate education has been accused of “winding down
toward mediocrity with a curriculum described as
‘chaotic’, a “disaster area’, or “rotten to the core”.
“Universities have mortgaged the nation’s scientific future and
its economy competitiveness by ignoring undergraduates.”
“The professors--working steadily and systematically--have\destroyed the university as a center of learning and have
desolated higher education, which no longer is “higher”
or much of an “education”.

The impact of research on teaching
“Most scholarly activity is either the sterile produce of requirements
imposed by philistine administrators or a form of private
pleasure that selfish professors enjoy at the expense of
their students.”
“The tension between research and teaching in universities goes
back almost as far as the American research university itself.
But that tension has been higher than usual lately, with with
cost-cutting pressures on campuses and increasingly sharp
scrutiny by outsiders on the quality of undergraduate learning.
Despite frequent affirmations of the importance of teaching,
most of the prestigious research universities still emphasize
research and publication--not teaching ability--for tenure,
for promotion, and in the general ethos that shapes
reputations.” (Washington Post)
Despite widespread lip service to the notion that
teaching ability is just as important as research,
and that it ought to be commensurately rewarded,
the opposite emphasis persists to a dramatic
extent in graduate schools and academic departments.
It begins with the way graduate students are recruited,
trained, and funded--with, for instance, the most
attractive fellowships offered so students can afford to
finish their dissertations without the distraction of
teaching to earn money.
“The faculty in research institutions admit that teaching is of less
importance to them than research...that their interests are in
research. I am not attempting to make a value judgment, but
wish to convey that there must be a balance if our
institutions are to be held accountable to the public.”
(Gov. James Thompson, Illinois)

Some threats
“Let me be blunt: universities are not fulfilling their obligations.
Universities have to return to giving more than lip service
to the importance of teaching. Ezra Cornell declared that he was
founding ‘an institution where any person could find instruction in any study.’ His stated intention was to found an institution where any researcher could find grants from any funding source. We at the federal level have to figure out some way to structure research grants so that they do not become disincentives to teach.” (Rep. Sherwood Boehlert, NY)

“The public has a right to know what it is getting...the right to know and understand the quality of undergraduate education. They have a right to know that their resources are being wisely invested and committed.” (National Governors’ Association)

2.2. Concerns from Within the Academy

Faculty Culture

Students contend that professors are so busy pursuing their research interests that they neglect undergraduate life. Most frequently mentioned as missing are little things like keeping regular office hours to see students, volunteering to be academic advisors, and just having a cup of coffee with students.

“The language of the academy is revealing: professors speak of teaching loads and research opportunities, never the reverse.”

“Research is called “my work” while teaching is called “my load”.

“The sign of real success is not having to teach at all. Teaching is looked at not as the advancement of knowledge, but the interruption of research.”

Curriculum

There is a growing sense that the competitive demands of specialized scholarship and other developments have placed an irreparable rift between graduate and undergraduate education and may have impaired the capacity of research universities both to remain centers of modern scholarship and to fulfill their broader educational functions. (HTS)

The real problem is that teaching and research are TOO CLOSELY RELATED. At the root of our unmet challenge in undergraduate education is the failure to distinguish between the transmission of knowledge and the development of a capacity for inquiry, discovery, and continued learning. (HTS)

The predicament is that they are transmitting what they know--and love--with little awareness of what the student needs to learn. (HTS)

The difficult is that the specialized focus of our scholarship may have given us a misguided notion of what teaching is supposed to be. We need to focus our pedagogical efforts on the spirit and capacity for learning, and on the excitement of inquiry and discovery, rather than on the transmission of knowledge. (HTS)

This may require that faculty separate their teaching functions from their research responsibilities. (HTS)

Will we have to choose between a key role in the nation’s research enterprise and our traditional educational functions? (HTS)

University Priorities

“Undergraduate education is trapped in an infrastructure that rewards research and denies those same rewards to those fulfilling the mission of undergraduate programs. The practices of the research community, college and university administrators, state and federal governments and agencies, and private foundations have created and reinforced the value system that produced and sustains this dichotomy.” (Sigma Xi)

Biggest issue relates to the meaning of changes for the relationship between scholarly commitments and undergraduate education...and to our obligations to
research and our responsibility for graduate education. One increasingly hears from faculty that they would rather work with postdoctoral students than with graduate research assistants because it allows them to accomplish their immediate scholarly objectives. Moreover, the increased disciplinary specialization of the faculty also has an important impact on the structure of our educational programs. (HTS)

“The exclusive concern with research in the training of PhD students— to the neglect of any concern with teaching or with any professional responsibility other than to scholarship— has encouraged college faculties to abandon the sense of corporate responsibility.”

The “research driven” nature of education requires us to invest a lot more capital for each student, scholar, degree if we are to continue to operate at the scholarly frontier (e.g., 5% increase per year during 1980s) (HTS)

2.3. Concerns about the Impact of Federal Policies and Programs

Priorities of Federal Agencies

“There is increasing speculation that the imbalance between the research and educational roles within the NSF... and other federal agencies... has been a factor contributing to the growing imbalance in academic institutions.”

“There is an unfortunate (pernicious) tendency both inside and outside of NSF to regard activity in research as more valuable than activity in education. A push toward excellence in research and the phase-out of several NSF programs for support of undergraduate education in science and engineering has led to this situation.” (Joe Ballentyne, VP-Research, Cornell)

“A number of strong factors have had major impacts on UG education at Cornell and similar institutions during the past 20 years. A push toward excellence in research and the phase-out of several NSF programs for support of undergraduate in science and engineering.” (Joe Ballantyne, VP Research, Cornell)

Financial Impact

“Another major concern is the increasing tendency at NSF and other federal agencies to require cost-sharing or matching on grants. This, in effect, diverts funds away from other priorities such as teaching.”

Faculty Culture

“The worth of a faculty member is often judged by his or her success in the competitive process of seeking research grants. A national competitive process for seeking funds for innovative teaching and curriculum improvements would also give young faculty visibility and “credit” in the tenure process. Without this there is less incentive for faculty to participate in innovative teaching.”

“The most important think the NSF can do for science education is to increase the prestige and respectability of teaching.”

2.4. A Summary of Concerns

The Importance of Listening to Criticism

It might be easy to answer and dismiss these critics one by one with logic, or a righteous dismissal of any who would question our purposes and privileges. And of course, there is much that is refutable in the recent spate of books and articles from he right and the left that question our performance and even reject the very foundation of what we do. But I believe it is a mistake to simply dismiss our critics.
Rather we should pay attention to what they say, since what they all appear to have in common is a question of our commitment to fundamental academic values. Besides, the truth is that we can no longer ignore them even if we wanted to. They will not go away.

To the extent their criticism is constructive, we should try to hear it. To the extent they are wrong, we should try to answer them with a compelling affirmation, a renewal of our vision and purposes, a confirmation of our unique community rights and responsibilities arrived at through extensive debate and discussion among ourselves and with our many constituents.

Observers condemn:
- Formless nature of UG curriculum
- Lack of personal attention from senior professors
- Huge classes broken into sections taught by inexperienced graduate students
- Low or nonexistent faculty teaching loads (6 hours per week!!!)
- Flight from classrooms to research
- High priced consulting, businesses, etc.
- Costs of education
- Gross materialism on part of universities (fund-raising, lobbying, etc.)

Particular Concern: Teaching vs. Research
Next to college curriculum, no aspect of university education has provoked more complaints that the faculty’s preoccupation with research at the expense of teaching.

It is widely believed that institutions slight their students when they emphasize research in making appointments and refuse to promote unproductive professors even though they are highly successful classroom teachers.

Critics condemn the bulk of scholarly activity either as a sterile product of requirements imposed by philistine administrators or as a form of private pleasure that selfish professions enjoy at the expense of their students.

Of course there is a great deal of misguided rhetoric on the tensions between research and teaching. Countless distinguished researchers are devoted to teaching and do a marvelous job. (HTS)

Some Caveats
- Who is concerned?
  - Note: marketplace is NOT telling us that teaching is a problem--rather media, critics, and parents are!
  - David Gardner notes that numerous studies over past 30 years indicate that students from research universities tend to be the most satisfied.
  - Hanna Gray believes UG education has improved dramatically over the years--but we really should now dwell on past and present (as critics have) but rather focus on the future. We should avoid be reactive.

Note quantitative measure sof value-added tend to support Gray’s belief (see GRE data below)

A Cautionary Note
- Most public criticisms fall into two categories:
  - i) cost: by assuming all universities cost $20 K/y
  - ii) research: all universities do too much research
In reality, most universities (2,900) are inexpensive and do NO research. Only the most elite privates are expensive...and only the research universities do significant research. Perhaps fewer than 10% of universities do this. Hence, in reality, the public attack is suggesting that we make these few universities like all the rest... That we make Harvard more like South Dakota State... In a sense, the public wants to convert those few institutions they really respect...into those they do not. If the Harvards and Michigans are doing things so poorly, then why does everyone want their children to attend them...and why do employers always want to hire their graduates?

Gordon Gee:
The difference between whether a university is excellent or elitist depends on whether you child was admitted or not...

Taxonomy of higher education: 3,500 institutions
- 4-year colleges
- comprehensive universities
- research universities
- AAU universities
- university college:
  That part of a UNIVERSITY that offers undergraduate instruction and grants a bachelors degree.

Unique role of research university in America
Those who speak up for teaching tend to dismiss research with hardly a word about the reasons that have led society to devote so many billions of dollars to its pursuit.

Core of basic research (Frank Press)
It is clear that the public research university... ...an institution for which the University of Michigan is not only the prototype, but perhaps also the flagship... ...touches the lives of a great many people in a great many different ways...

Through education, research, and service... through health care, economic development, and ...yes...even through a sense of pride in their athletic accomplishments.

Even without undergraduates, these institutions would be essential both for our state and our nation...

3. The Importance of the Research University
3.1. The Role of the Research University
Few realize the the ever-accelerating pace of change in our nation...and in the world!
Think about it for a moment...
The students we are educating today will spend most of their lives in the next century...they will be citizens of the 21st Century...
Our students will inherit a much different America than you and I have known...

i) It will be future in which our nation becomes a truly multicultural society, with a cultural,racial, and ethnic diversity that will be extraordinary in our history
In which those groups we refer to today as minorities will become the majority population of our nation in the century ahead...

In which women take their rightful place as leaders
of America...

ii) It will be a future in which America will become "internationalized"... in which every one of our activities must be viewed within the broader context of participation in the global community...

Whether through travel and communication, the arts and culture, the internationalization of commerce, capital, and labor, we will become increasingly interdependent on other nations and other peoples.

Further, as the destination of roughly half the world's immigrants, the United States is rapidly becoming a "world nation" with not simply economic and political but strong ethnic ties to all parts of the globe.

iii) The Age of Knowledge

But there are even more profound changes underway...

Looking back over history, one can identify certain abrupt changes, discontinuities, in the nature, the very fabric of our civilization...

The Renaissance, the Age of Discovery, the Industrial Revolution

There are many who contend that our society is once again undergoing such a dramatic shift in fundamental perspective and structure.

Today we are evolving rapidly to a new post-industrial, knowledge-based society, just as a century ago our agrarian society evolved through the Industrial Revolution.

In a sense, we are entering a new age, an age of knowledge, in which the key strategic resource necessary for our prosperity, security, and social well-being has become knowledge--educated people and their ideas.

Knowledge will play the same role that in the past were played by natural resources or geographical location or unskilled location...

In the knowledge-intensive future that is our destiny it seems clear that education in general... higher education in particular... and the research university most specifically are rapidly becoming the key ingredients determining the strength, prosperity, and social-well being of our nation.

Just think of the challenges which cry out for attention

• the plight of our cities,
  the development of an underclass
  polarization of American society
• greenhouse effect and global change
• international competition
  Pacific Rim or Europe 1992
• health care: cancer, heart disease, AIDS
• new frontiers: outer space
  or spaceship Earth

In all advanced societies, our future depends to an ever increasing extent on new discoveies, expert knowledge, and highly trained people. Like it or not, universities are our principal source of all three ingredients. (Bok)

The solution of virtually all the problems with which government is concerned: health, education, environment, energy, urban development, international relationships, space, economic competitiveness, and defense and national security, all depend on creating new knowledge---and hence
upon the health of America’s research universities”

3.2. **An Example: The University of Michigan**

An example of the ever more critical role played by the research university is our society is provided by an inventory of several of the activities of the University of Michigan.

This past year the taxpayers of this state contributed over $270 million through state appropriations to the University of Michigan.

What did they get in return?

**Educational Impact**

i) an outstanding education of roughly 50,000 students (80% of them Michigan residents!!! Including 29,000 undergraduates)

ii) the production of 12,000 graduates at all degree levels in all disciplines and professions

**Economic Impact**

i) In comparison to the $270 M invested by the state, the UM attracted to Michigan over $402 million in federal support--most of which came in the form of sponsored research contracts and student financial aid, and medical care.

ii) Further, the students attracted to our programs contributed roughly $300 M additional dollars to tuition and fees...

iii) In addition, the auxiliary activities of the University contributed another $800 M to the state’s economy...

iv) Or $1.7 billion, in all -- a multiplying factor of six-fold

**Economic Development**

i) But far beyond that, we estimate the true economic impact of the University multiplies its state appropriation by at least a factor of ten or more...

ii) For example, the UM’s engineering programs--supported in part by the Research Excellence Fund, are credited as a key to the recent growth of a $5 billion industry in industrial automation in the southeastern Michigan area.

iii) Each year the University spins off dozens of new companies, creating new jobs and attracting new dollars to our state

iv) Each year the UM attracts to Michigan new companies... as evidenced by the announcement in Ann Arbor that Philips Electronics has just agreed to site a major $200 M factory in the Ann Arbor area

v) Or exciting new ventures such as...the National Research and Education Network...CEISIN

vi) Each year the UM produces thousands of engineers, scientists, business executives, lawyers, teachers,...and all of the other professionals so necessary to compete in the knowledge-based economy which characterizes our world.

**Health Care**
But of course there are so very many more payoffs from this investment.

Last year, over 750,000 patients were treated in the UM Medical Center...regarded as one of the world’s great centers of quality health care.

Indeed, our recent market surveys have indicated that essentially every family in this state at one time or another has had one of their members referred to and treated by our doctors.

Further, the through its activities in medical research continues to have great impact on the people of this state...

...whether it was conducting the clinical trials for the vaccine developed by one of our faculty members, Dr. Jonas Salk...

...or the recent announcement last fall that a UM team of scientists had identified and cloned the gene responsible for cystic fibrosis, neurofibromatosis, and cholesterol intolerance.

I would suggest there is not a person in this room whose life has not been...or will not be touched at one time by our doctors and medical scientists!

Social Change

But there is so very much more...

The University continues to serve as one of the great engines of social change in our state...

Whether it is the Michigan of the Big Chill...

...the long tradition of student activism awakening the conscience of our society

The Teachins of the 1960s against the war in Vietnam

EarthDay in the 1970s to raise concerns about the environment

Our celebration of Martin Luther King Day last month with an educational experience involving thousands to highlight the importance of tolerance and mutual understanding

Or the extraordinary impact of our regional campuses as they educate first generation college graduates

Or the leadership we are providing in addressing the needs of our minority communities...as evidenced by the Michigan Mandate (hand out)--widely regarded as one of the nation’s most visionary approaches to affirmative action.

It is clear that the public research university...

...an institution for which the University of Michigan is not only the prototype, but perhaps also the flagship...

...touches the lives of a great many people in a great many different ways...

Through education, research, and service... through health care, economic development, and...yes...even through a sense of pride in their athletic accomplishments.
Yet as important as these institutions are today in our everyday lives, it is my belief that in the future they will play an even more critical role as they become the key player in providing the knowledge resources...knowledge itself, and the educated citizens capable of applying it wisely...necessary for our prosperity, security, and social well-being.

It has sometimes been said that the best way to predict the future is to invent it. And perhaps this is the best definition of the role of a major research university such as the University of Michigan: to invent the future, through the knowledge we produce on our campuses, and through the graduates we educate. And perhaps this is the most important role of all...that of preparing Michigan for the future!

3.3. Paradoxes and Dangers

Yet the unique character and role of the research university is neither understood nor appreciated by the American public at large, or by most of their elected public leaders. Indeed, even the term "research" university is viewed with skepticism and derision by the public.

This is ironic since one of things we have done well as a nation is to build a system of research universities envied by the rest of the world.

Our universities educate more students and conduct more research better than any other national system of higher education in the world.

Our great research universities have done an astonishing job of transferring their knowledge of science and technology to society at large, and done so, I might add, with a fair amount of class, compassion, integrity, and humility.

Beyond question, the scientific research done under the sheltering arms of research universities has improved human life, prolonged human life, enriched and protected and comforted human life.

Many of the most progressive social reforms in this century also have originated in research universities. Countries as diverse as Japan and the USSR look to our universities as models for reforming their own.

Much of this criticism is simplistic and overstated, and it ignores the extraordinary contribution of universities to American intellectual and cultural life and to our economic strength and national security.

While the American research university is clearly the envy of the rest and the world, it is under scathing attack at home--from leaders in the public and private sector, and from the public at large.

3.4. Basic Objectives:

What do we want:

i) We want universities to produce research of a quality second to none so that we can enlarge our knowledge, renew our culture, and produce new insights to help us conquer disease, promote technical progress, and overcome our social problems.

ii) Give young people an education that will prepare them to live productive lives; to be knowledgeable, critical members...
of our democratic society; and to appreciate the human experience and the world around them.

iii) Want our colleges accessible enough so that all who seek education can find opportunities.

iv) Since universities are our principal source of expert knowledge and highly trained people, we need them to offer the kinds of education, advice, and critical analysis that society needs in order to prosper and move forward.

Different segments of higher education pursue these objectives in different ways. Research universities contribute to all of the ends above.

It is clear that America’s highly decentralized system of 3,500 institutions accomplishes these goals far better than the government-controlled systems that predominate in the rest of the world.

Unless we are prepared to recommend another system, it makes little sense to condemn the one we have for shortcomings intrinsic to its very nature.

4. Folklore Concerning the UG Education in the Research University

4.1. General Observations

We need to recognize that there are several groups who have developed different sets of folklore:

- faculty
- administrators
- the critics
- students
- parents

While it is important to seek empirical data, we should also be aware that different methodologies will shed different perspectives (e.g., data collections, surveys, focus interviews, narratives).

4.2. Folklore Concerning the Impact of Research on Teaching

1. The quality of undergraduate education in research universities has deteriorated over the past couple of decades.

Measures: How can we assess the value-added by the undergraduate education provided by various institutional types...and over time?

i) SAT/GRE (or LSAT, GMAT, MCAT) score correlations

ii) Major prizes (Rhodes, Marshalls)

iii) A survey of major efforts to develop methods to assess undergraduate and learning and achievement.

2. Small liberal arts colleges which stress teaching do much better in educating undergraduates than to large research universities.

Measures: Value-added measures (above)

3. Undergraduates rarely see faculty. They are instead taught primarily by teaching assistants, most of whom are second-rate instructors and many of whom cannot even speak English.

Measures:

i) Information about average balance in course experience of undergraduates (large/medium/small classes) over time and institutional type

ii) Faculty teaching load (SCH, contact hours) vs time

iii) TA vs faculty teaching loads vs time

iv) US vs foreign TA components vs time

v) Comparisons of student course evaluations of faculty, TAs,
US vs foreign TAs, etc.

Idea: Could we get a cross correlation between faculty student course evaluation ratings and research activity (similar to what we did in Engineering in the early 1980s)

4. Faculty are teaching less these days, devoting more and more of their time to sterile research in unimportant areas.
   Measures: Faculty effort (teaching load, research load) vs time

5. Undergraduates in large research universities are herded from one large lecture course to another, rarely getting an opportunity to interact directly with faculty.
   Measure: Student class size distributions vs time and institutional type

6. There is some concern that part of the reason for the decline in student majors in science, mathematics, and engineering has to do with the demanding curriculum and rigorous grading practices in these fields compared to majors in the humanities and social sciences. Students therefore may be selecting the "path of least resistance" to postgraduate professional programs by majoring in these latter fields.
   Measure:
   i) Are there significant differences in grade point averages between the sciences and humanities and social sciences?
   ii) Are the program requirements (SCH, work effort required, etc.) significantly larger for the sciences?
   iii) Can we benefit from any previous studies (e.g., Williams College study)

7. The reward structure (salary, promotion, tenure) of the research university stresses research activity at expense of teaching.
   Measure:
   i) salary data on faculty correlation with respect to activity
   ii) rewards and honors (university and national level)
   iii) tenure attrition rates
   NOTE: At the fall AAU meeting, several presidents with backgrounds in economics noted that the discussion about the faculty reward structure was very superficial. High prices (e.g., salaries) do not reflect importance. Rather prices are just "production signals" reflect the imbalance between supply and demand. If we demand good teaching, then it will happen. We do not need to influence this by artificial pricing (salary) adjustments...

8. Students and parents aren't getting their money's worth at these large research factories. The universities are taking tuition dollars and diverting them to support research.
   Measure: Longitudinal analysis of university funding

9. The lack of faculty role models in the classroom have discouraged students from considering careers in college teaching.
   Measure:
   i) The fraction of graduating seniors which go on to graduate school (or earn PhDs) rather than law, medical, or business schools.
   ii) The fraction of graduating seniors going on through the PhD and then into faculty positions in each institutional type.

10. Little thought and even less effort has been given to the design and implementation of an undergraduate curriculum (or UG experience) which takes advantage of the resources of the modern research university. Instead, these institutions generally approach teaching much like small liberal arts colleges—although they clearly cannot provide the personalized attention that characterizes these latter institutions.

11. The best graduate students come from small liberal arts colleges
   Measure: A survey of the undergraduate institutions of the science graduate students at the top 25 research universities

12. Shapiro suggests that part of the problem may be that the teaching and research activities of faculty may be too closely related. The specialized focus of our scholarship has propagated into the undergraduate curriculum, distorting it away from the goal of a liberal education. The faculty tends to
focus more on the transmission of knowledge they know--and love--
with little awareness of what the students need to learn (e.g., the
excitement of discovery and a capacity for analysis and continued
learning.)

HTS Points
1) As long as discussion is “teaching vs research”,
it is going nowhere (quality of UG education is
NOT correlated with absence of scholarship)
2) There is such a thing as a free lunch--people
can do things better--and hence improve quality
and productivity without increased costs.
Here research universities have a real opportunity--
but we have to do what we do better--new ideas,
new ways of doing things better
3) Lots of discussion about reward system--but
this discussion is very superficial. High prices do
not reflect values or importance. Prices are just
production signals reflecting imbalance between
supply and demand--not importance. If we demand
good teaching, it will happen. Don’t need to
influence this by artificial pricing.

4.3. Folklore Concerning the Impact of Sponsored Research Policies
1. The importance of sponsored research dollars for the support and
prestige of universities has distorted the academic culture and
faculty reward system in the research university.
2. Teaching has viewed as a “labor”, not an “opportunity”. As a
result, teaching load has now become a factor in hiring/retention
negotiations.
3. Cost-sharing and leveraging requirements have distorted institutional
priorities, resulting in the shift of institutional resources away from
teaching and into research.
4. The increasing degree to which federal research dollars are used to
support people with no direct involvement in teaching (e.g.,
permanent research staff, postdocs) has distorted academic
priorities, building a para academic subculture (and supporting
bureaucracy) with no relationship to the teaching function of
the institution.
5. Faculty effort has been diverted away from teaching by the excessive
requirements of grantsmanship--proposal writing, etc.
6. The shift of federal research support into massive centers--
many of which are quite separated both physically and organizationally
from the teaching units--has further diluted institutional teaching
priorities.
7. The need for graduate student labor to build research productivity of
faculty and departments has led to the buildup to teaching
assistantships as primary mechanism to support graduate student
populations rather than to meet teaching loads. Further, since US
nationals generally can acquire fellowship or RA support, foreign
nationals are increasingly populating the ranks of TAs.
8. Sponsored research support of academic term appointment fractions can
have a major impact on teaching in several ways:
   i) First, in the ideal case, the time that a faculty devotes to sponsored
research is supported by the grant, thereby relieving this salary
component for the hiring of the substitute teaching staff.
However, to the degree that the federal agency does not
adequately support the research time, this requires the
faculty member--or the institution--to reallocate effort of resources
away from teaching activity.
   ii) Changing and conflicting federal policies with respect to academic
term appointment can whiplash institutions, forcing them to
either reallocate from teaching to research in order to “cost-share”
on the grant via the support of the faculty members time.

9. Impact of graduate instruction vs undergraduate instruction. (Note: This is not a negative, but rather a recognition that graduate education is not only research supervision, but very much hands on teaching. To the degree that research universities have a responsibility to teach graduate students as well as undergraduates, this has to be included in measuring the faculty teaching load! HTS: “There is a growing sense that the competitive demands of specialized scholarship and other developments have placed an irreparable rift between graduate and undergraduate education and may have impaired the capacity of research universities both to remain the centers of modern scholarship and to fulfill their broader educational functions.”

10. The NSF—and other federal agencies—have sent out clear signals over the years that research is more valuable—to them, at least—than education. To quote Joe Ballentyne, VPR-Cornell: “There is an unfortunate (pernicious) tendency both inside and outside of NSF to regard activity in research as more valuable than activity in education. A push toward excellence in research and the phase-out of several NSF programs for support of undergraduate education in science and engineering (in the early 1980s) has led to this situation.” “There is increasing speculation that the imbalance between research and educational roles within the NSF…and other federal agencies…has been a factor contributing to the growing imbalance in academic institutions.”

5. What are the Key Issues?

5.1. General relationship and balance between teaching and research. Of course there is a great deal of misguided rhetoric concerning the perceived tensions between teaching and research. Indeed, there is even some evidence suggesting that the presence of research can actually enhance the learning environment for undergraduates (e.g., NSF’s SAT/GRE correlations).

Nevertheless, it is also clear, that at least in some institutions, the strong pressures generated by the sponsored research culture have distorted the balance between teaching and research.

5.2. Distortion of the “faculty culture” (reward structure, etc.)

There are growing concerns about the distortion of the faculty culture by sponsored research policies and the impact they have had on faculty rewards (hiring, promotion, salary, recognition).

These have led to an increasing withdrawal of faculty from undergraduate and graduate instruction.

One increasingly hears from faculty that they would rather work with postdoctoral students or research staff than graduate or undergraduate students because it allows them to accomplish their immediate scholarly objectives.

The Academic Scholar survey (1989) revealed that 71% of faculty members indicated that their principal interest lay in teaching rather than research.

Cultural factors in the academic community now place a low premium on teaching, and the philosophy of teaching as a “weeding out” process were obstacles that must be addressed.

The university research enterprise places too much emphasis on research at the expense of teaching.

Grant-funded research has seriously distorted the faculty culture in such a way as to erode the quality of undergraduate education.

Competition among universities is creating situations
in which teaching load has now become a negotiable item in luring star faculty.

At some doctoral institutions leading researchers have no obligation to teach...or they teach only graduate seminars. Even in non-doctoral institutions, there is encouragement for faculty to compete for grants to "buy release time" from teaching.

Major changes in the “corporate culture” of universities are necessary to rebalance the relative priorities of teaching and research.

5.3. **Nature of undergraduate education**
Harold Shapiro suggests that part of the problem may be that the teaching and research activities of faculty may be TOO closely related.

The specialized focus of our scholarship has propagated into the undergraduate curriculum, distorting it away from the goal of a liberal education.

The faculty tends to focus more on the transmission of the knowledge they know--and love--with little awareness of what the student needs to learn (e.g., the excitement of discovery and a capacity for analysis and continued learning).

5.4. **Quality of undergraduate education**
Don Kennedy:

“We need to talk about teaching more, respect and reward those who do it well, make it the first among our labors. It should be our labor of love and the personal responsibility of each of us.

LS&A Planning Committee on UG Experience
Cited for a reconstruction of UG education that focuses on the role of the college faculty member as a teacher rather than as a research scholar.

There has been a serious erosion in student interest in science education over the past 20 years:

...proportion of freshmen intending to major in science and math has dropped from 11.5% to 5.8%

...40% of those entering college intending to major in science drop out after entry level courses

...another 20% drop out before completing major.

Most freshmen view entry-level courses in science, mathematics, and engineer as inaccessible--or, if accessible, unrewarding to them.

The common practice of using entry-level courses as barriers to protect more advanced programs from all except the most able and the most committed still persists, and at worst, students view these classroom environments as destructive and hostile.

HTS believes that less demanding nature of humanities and social sciences is REAL reason for S&E attrition--students taking path of least resistance to a degree.

We have design undergraduate education as a filter...and what we need is a pump for the pipeline.

5.5. **Cost considerations**
National emphasis on excellence in university research may have negative effects on UG education in some universities. Financial and other resources may be diverted from UG instruction, or a climate in which research accomplishments are valued above educational ones may cause instruction of UGs to be shortchanged.

It is not clear that the issue can be usefully addressed statistically. It is assumed that beyond a certain level of research activity at a
university, marginal benefits dimish.
The sketchy evidence set out below suggests that there may well be universities in which research activity is actually financially infringing upon UG education.
The more difficult, underlying, problem is that of the nationwide academic competition for prestige, good students, and external funding that has increasingly focused on excellence in research.
It is possible that additional federal actions underlining the importance of excellence in education as well as in research could modify the balance of values somewhat.
Testimony shows that faced with inadequate resources to meet many simultaneous funding possibilities, some universities strain to provide for research programs at the expense of education--especially undergraduate education:
i) the underrecovery of costs of research from the federal government leads to reduction in resources for education, as the university is now obliged to come up with resources to complement those from external sources
ii) currently available resources, including federal funds, are not sufficient for the balanced support of schools current educational and research aspirations, but old patterns of behavior have lead to misallocations of resources, overextending research budgets.
iii) research is simply such a preeminent value of universities and the nation that temptations to divert funds from education are likely to remain irresistible at some institutions.
Other points:
Surveys suggest that university decision mechanisms and incentive systems lead to the funding of additional research with university funds, instead of spending allocations in the face of greatly increased marginal costs. For example, 20% of faculty research time dollars went into research related categories rather than substitute teaching.
Another example is the allocation in some universities of a portion of recovered indirect costs back to the department and to the PI that brought them in--funds then used for new research rather than to cover costs.
A federal decision to redistribute its support of research universities from research projects to research infrastructure, or from research to undergraduate, would relatively shrink research project activity, unless universities are determined to maintain the present distribution of funds by shifting their own.
Other notes:
“Substantial differences in cost (expenditures per student) do not necessarily connote significant differences in educational outcomes.”
The government has a large stake in excellent university research; it has a large stake in excellent UG education as well. Research may well impose significant opportunity costs on UG education at some universities. It is not clear that NSF--or the federal government--can do much about this situation if it exists. Total federal support of universities is not likely to increase by very much soon, nor does the government have much control over the distribution of university spending or incentive structures. It therefore seems that the universities where UG education is suffering must take the lead in addressing the problem.
The “research driven” nature of education requires institutions to invest increasing levels of capital (equipment, support, etc.) per student if they are to continue to operate at the scholarly
frontier. (Throughout the 1980s, instructional costs have risen at 5% per year above inflation.)

The increasing tendency to leverage institutional support of research by the cost-sharing policies of federal agencies has drawn resources away from instructional programs.

6. What Questions Need to be Addressed?

6.1. General

What is the impact of research on the quality of teaching?
Can a university do good research and good teaching?
NSF data suggests that the answer to this question is yes. However we need to look at specific cases.

What is the impact of research on student preferences?
Attrition in majors? Postgraduate career decisions?
Are professors who are good researchers also good teachers?
Major myth is the alleged conflict between research and teaching is that a professor cannot be good at both.
The view that teaching and research have been and must remain separate and unequal is more myth than reality.
Are research activity and teaching quality correlated?
The best research universities...like Michigah...can and should demand of faculty members both “superb research and superb teaching”.
(While there is not strong evidence that research and teaching are highly correlated, there certainly is not evidence that a good researcher is necessarily a bad teacher.)

How does one take advantage of the extraordinary learning environment offered by the research university?

What information is available on the effect that faculty research has on the quality of undergraduate education? Do we need additional studies?

What happens to undergraduate education when one increases research? (a dynamic question).
(Studies indicate that when a faculty member increases time spent on research activity, it usually does not come from teaching but rather from their private lives.)

6.2. Specific Questions for the Academy:

Faculty

UG course loads at AAU universities have declined. Even if this has been offset by an increase in faculty size, is there reason to believe that teaching loads should be increased?

Can that be done without undermining the quality of graduate teaching and research?

Is there an excessive reliance on TIAs in situations in which the use of faculty would improve quality? If so, then should one improve quality of TA training...or increase faculty teaching loads?

Flexibility in Teaching Assignments

Is there a desirable norm for faculty effort (25% UG, 25% grad, 50% research) or should one allow more flexibility...particularly during career evolution.

Should more senior faculty be in lower division courses?

Evaluation and Rewards

Are teaching productivity and quality appropriately valued in faculty personnel decisions?
Should more weight be given to adequacy of out-of-class contributions to education, e.g., advising?

Curriculum

Should one find more extensive systematic ways to increase UG involvement in research?

Is the organization of universities for UG education flexible
enough to reflect interdisciplinary areas?

Teaching support systems
Should more effort be devoted to helping faculty improve teaching skills?
Should there be institutional policies on TAs:
  - Require all to have training prior to teaching?
  - Require foreign nationals to pass English tests?
  - Bar TAs with low evaluations from teaching?

6.3. Specific Questions for NSF
What is the impact of NSF policies on undergraduate instruction?
How can we modify NSF research policies so that they actively encourage rather than passively discourage attention to teaching?
Should the NSF try to influence the culture of academe to help define a proper balance between the undergraduate teaching and research?
If yes, then what should be done and who in the NSF should do it?
How might one design programs which take advantage of the extraordinary nature of the environment provided by research education in a way that the UG experience would be benefited.

6.4. EHR Study
The Education and Human Resources Committee of the National Science Board is conducting a major study to examine the impact of research on undergraduate education:
i) An examination of the “folklore” concerning the impact of research on teaching in an effort to separate myth from reality.
ii) An assessment of the impact of federal research policies on undergraduate education--e.g., possible distortion of the academic culture to draw faculty effort and institutional resources away from teaching.
iii) An assessment of ongoing federal programs (primarily NSF) aimed at improving the quality of undergraduate education.
iv) Recommendations for policies and programs aimed at improving the quality of undergraduate education.

While much of our interest will be focused on undergraduate programs in science, mathematics, and engineering, we also believe that aspects of the study will span all disciplines.

Further, since there is such a wide diversity in institutional types, we will likely focus our first efforts on two classes of institutions:
• Comprehensive research universities (AAU set)
• Private liberal arts colleges (“Oberlin 40”)

Specific Studies
Institutional Studies
What are the factors that make for a “quality” UG education?
What kind of institutions appear to have these in greater abundance than others?
Survey of major efforts to assess UG education quality

Faculty Study
Who are the faculty that teach undergraduates?
What are the characteristics of the teaching regime?
  - (class size, teaching load, barrier courses, foreign TAs)
What is the distribution of teaching responsibilities among faculty?
  - (young vs old, foreign vs citizen, tenure vs nontenure)

Student Study
What makes for a quality educational experience from the student’s perspective?
What evaluate criteria do they use?
Is there a relationship between the number of students that major in science and engineering and the grading practices of the university?
Are the course requirements for S&E majors significantly greater than for other majors?
To what extent has there been grade inflation? If so, does it differ between S&E majors and other majors?

Research Study
What is the effect of research-related requirements on undergraduate interaction?
Is the modern research university taking advantage of their undergraduate in terms of their potential contributions as RAs? As TAs? Is their a cost to their use for this purpose?

Cost Study
What is the “full cost” of research? Of undergraduate education?
What can be learned from the accounting procedures of selected universities?
Are tuition dollars being diverted from undergraduate education to graduate education and research? To other activities?

Graduate Study
Where are our doctoral students getting their undergraduate degrees?
What is the rate at which students go onto graduate school? By institution?
By discipline?
What is the impact of graduate programs on undergraduate education?

7. What We Know Thus Far:
7.1. A Taxonomy of Colleges and Universities
Research-Education Spectrum (Figure)
Types of Institutions by Scope of Service (Figure)
Numbers of Institutions
Doc 1: 20
Doc 2: 40
Doc3: 125
Ed 1: 28
Ed 2: 78
Ed 3: 356
Ed 4: 755
2-y: 1.330

FTE Enrollments (1988)
Doc 1: 4.8%
Doc 2: 7.9%
Doc3: 15.0%
Ed 1: 0.6%
Ed 2: 6.4%
Ed 3: 17%
Ed 4: 13%
2-y: 35%

Bachelors Degrees (1988)
Doc 1: 8.0%
Doc 2: 12.5%
Doc3: 22.6%
Ed 1: 1.3%
Ed 2: 10.2%
Ed 3: 25.0%
Ed 4: 18.9%
2-y: 1.6%

7.2. The “Value-Added” by an Undergraduate Education
Peter House, Division of Policy Research and Analysis (STIA)
Study
Sample: Over 50,000 students majoring in S&E whose 1987 GRE score (quantitative and verbal) could be matched by ETS with SAT score
Variables: GRE, SAT, gender, race, UG major, UG school
Value Added: Average additional to a student’s total GRE score associated with going to a particular school, irrespective of SAT, gender, minority, or UG major.

Taxonomy of Academic Institutions:
Raw Results of Value Added

Doc 1: 43
Doc 2: 37
Doc 3: 19
Edu 1: 37
Edu 2: 12
Edu 3: 0

Results:
1. The most prominent research institutions have the highest
average scholarly quality rating.
2. Doc 1 had the highest value-added, followed by Doc 2
(Note that even Doc 2 were higher than Edu 1)
3. Average education index is positively related to
average number of S&E bachelors degrees awarded,
except for institutions granting more than 3,000
degrees annually (note that UM awards about 2,500,
so it peaks for UM and UCB)
4. Average education index is positively related to R&D
intensity as measured by R&D spending per undergraduate
5. Average education index is positively related to
scholarly quality of faculty (1980 NRC reputational survey)

Other points:
1. Doctoral institutions are only 13% of all institutions, but
account for:
   ...45% of total enrollment
   ...nearly 50% of total degrees
   ...over 90% of academic R&D
2. There does not appear to be much different in undergraduate
enrollment-to-bachelors degree conversion ratios among
most institutional types (although a very modest advantage
to Edu 1 institutions...but very modest)...E.g:
   Cornell: 90%
   UM: 80%
   Reed: 80%
   T A&M: 80%
3. Within each institution type, per student spending declines
from type 1 through type 3 (although Edu 1 is slightly
higher than Doc 1).

Conclusions:
There is no quantitative evidence which supports the
supposition that, in general, strong emphasis on
research hinders the education of undergraduates.
Research university policies strongly emphasize research
achievements for tenure decisions, but this philosophy
has not apparently degraded the quality of their B.S
graduates compared to undergraduate colleges where
teaching skills weigh more heavily in tenure decisions.
Measures which could be associated with quality of UG
education are generally positively correlated with
research intensity indicators.
This analysis does not conclude that NO institutions exist
where research emphasis degrades the quality of
undergraduate education--only that such a phenomenon
is not strong and pervasive.
The analysis also does NOT conclude that the quality of teaching is better at research universities--only that the total educational experience, including peers, intellectual environment, and role models, appears to produce baccalaureate graduates of equal or better quality than those from institutions where education is heavily stressed.

Another Interesting Point:
It is well-known that SAT scores have been declining for the past 20 years
...due to broadening composition of college entry population
...due to deterioration of K-12 education
Yet the GRE scores have been increasing over this period:
From 1977 to 1988
...verbal: 500 -> 520
...analytic: 510 --> 540
...quantitative: 520 --> 580
This suggests that undergraduate education is taking a lower quality input and producing even a higher quality output...that is, that the value-added has increased substantially

7.3. Degree Production
Enrollment:
Total undergraduate enrollment has doubled since 1967, to 11.5 million in 1988, although the growth since the mid-1970s has slowed.
There has been a shift towards attending public institutions, whose enrollment share rose from 72% in 1967 to 80% in 1988. This shift reflects in part the rapid growth of 2-year colleges which are overwhelming public.
The number of undergraduates in research universities has essentially been stable since the mid-1970s.
In constant dollar terms, there has been little change in the amount of financial aid awarded to undergraduates. However, its composition has changed dramatically since the mid-1970s; grants have declined from 80% to less than 50% of the total, and loans have expanded proportionately. (Figure)

Popular Myth
Small liberal arts colleges produce an unusually large share of science degrees

Reality
Doctoral institutions are only 13 of all institutions, but account for...
...45% of total enrollment
...50% of total degrees
...over 90% of academic R&D
Degree totals mask differences in institutional size:
The average production of S&E bachelors for doctoral institutions is roughly 3:2:1
Doc1: 2,100 each per year for 20 institutions
Doc2: 1,3000 each/y for 40
Doc3: 750 each/y for 125
With the exception of the Ed2 (feeder) institutions, the remaining institutions tend to produce far fewer degrees annually.
Doc1 and Ed1 tend to be more S&E intensive than others, producing at least as many S&E degrees as BAs in other fields. (Figure)
There is not much difference in UG enrollment to bachelors degree conversion ratios among different institutional types.
Dropout rates are smallest for Ed1...and roughly comparable
for all other institutional types. 

NS&E baccalaureate holders tend to earn NS&E PhDs in the same class of institution in which they earned their BS. More graduates of Ed and Doc2,3 tend to earn PhDs in Doc2,3 than in Doc 1. (Hence suggesting there is little climbing ability)

There has been no change in the 1980s in the choice of NS&E PhD institutions by BS degree holders from the top research universities. These BS are 70% to 80% more likely to earn their doctorates in Doc1s compared to a proportional distribution among doctoral institutions.

The propensity to earn a PhD on the part of BS students from the most highly selective liberal arts colleges declined throughout the 1970s and early 1980s, but appears to be increasing again. These students are much more likely to earn doctorates than even the bachelors graduates of Doc1 universities.

The proclivity of NS&E bachelors to earn a PhD has fallen most sharply for BS holders from Doc1.

The baccalaureate origins of NS&E PhDs from DDoc 1 institutuions have changed little during the 1980s.

NS&E degrees increased fairly steadily from 110,000 in 1966 to 210,000 in 1985...and have now fallen back to 190,000. This occurred in all institutional types. Factors influencing fluctuations in the NS&E proportion of BS seem to apply equally in research universities and educutional institutions, even through this proportion is higher in research universities.

The research universities as a group are far more focused on NS&E than 4-year comprehensive institutions. They award about 55% of all NS&E.

Average 1989 starting salaries for new bachelors were high for graduates of research universities.

7.4. Teaching

Teaching Loads

One indicator of the quality of education at the undergraduate level is the relative number of PhDs on the faculty. Across all 4-year colleges, these average 70% of the full-time teaching faculty. Because none of the full time faculty grew at a rate commensurate with enrollment in the 1970s and 1980s, it has taken a growth in the number of teaching assistants to maintain a relatively constant student-teacher ratio. (Figure)

More specifically, student-teacher ratios for PhD level faculty crept up from 21:1 in the late 1970s to 23:1 in the late 1980s. Total student/teacher ratios appear to have been steady for a decade at 11:1. (Figure)

Fulltime equivalent enrollment per fulltime equivalent faculty teaching effort appears to have increased somewhat since 1975 for both institution types. (Figure)

Who is doing the teaching?

Self-support, fellowships or traineeships have been the primary sources of support for roughly 40% of full-time NS&E graduate students for the past 15 years. Research and teaching assistantships were the primary support for the remaining 60%. Both have been growing since the early 1970s, but research assistantships have increased more rapidly during the 1980s. (Figure)

Research universities employ roughly 40,000 TAs in the natural sciences and engineering. In the late 1980s, the physical sciences and engineering use the most, computer and environmental sciences the least, with mathematics and biosciences in between. The number of TAs has increased since the late 1970s for all fields but...
the biological and environmental sciences. (Figure)
The number of teaching assistants per 1000 FTE UGs declined for all doctoral types through much of the 1970s, then increased steadily back to 1973 levels except for the smaller research universities, which remain well below their past level. (Figure)
The number of total NS&E teaching assistants has increased for all three doctoral classes during the 1980s. Educational institutions make less use of TAs. (Figure)
The declining proportion of new PhD students with primary support from teaching assistantships reflects the increasing emphasis received by research. At the same time, a perhaps worrisome trend indicates than an increasing percentage of new PhDs with primary support from TAs are non-US citizens. (Figure)
In chemistry, physics, and mathematics, the percentage of foreign doctoral students increased by 12% to 36% in the 1980s. Over the same period, the fraction of PhD students supported by TAs declined from 31% to 23%, but the fraction of the declining share of TAs awarded to non-US citizens roughly doubled. (Figure)
In engineering, the percentage of new PhDs with primary TA support has traditionally been very low—a stable 10% for the past decade. Over the same period, the portion of non-citizens PhDs has increased from 43% to 53%, and the percentage of foreign doctorates supported by TAs rose from 48% to 72% of all such support! (Figure)

A shift in faculty effort

Over the past decade or so, there has been a gradual decline in the proportion of time doctoral faculty in universities and colleges spend on teaching. On the other hand, the proportion of time spent on research decreased through the 1970s but has increased again through the 1980s, in part because institutions with traditionally low levels of research activity are seeing a growing number of their faculty involved in this endeavor. (Figure)

PhD faculty whose primary or secondary responsibilities are either teaching or research spend an average of 765% of their time on these two activities; in small, highly selective liberal arts colleges, 85%. The average fraction of time spent on research declines from more than half at the top research universities to less than 15% at the least selective education institutions, with a corresponding increasing in teaching time. (Figure)
The portion of time spent on teaching relative to research appears to have declined in the past several years for all types of institutions, after increasing during the 1970s for the education institutions.

Carnegie surveys over two decades show:
... decline in prevalence of belief that teaching should be the primary criterion for promotion
... increase in agreement that tenure is difficult to achieve without publishing
In research/phdotal institutions
... only 30% of faculty agree that teaching should be the primary promotion criterion (60% for all institutions)
... 90% agree that tenure without publishing is difficult (50% for all institutions)

7.5. Faculty Characteristics
Composition

Almost 70% of academic faculty members are PhDs. Generally, the more selective schools have higher proportions of PhD faculty than the less selective ones. The PhD percentage of the most highly selective liberal arts colleges is about the same as that of the top research universities. More than 80% of faculty at Doc1s and Ed1s have a PhD. Less than 50% of faculty at Ed4 have a doctorate. (Figure)
The percentage of non-US citizens among faculty ranges from 3% to 8%. In general, the higher the selectivity, the greater the propensity for hiring non-citizens. However, the majority of foreign born doctorates teaching in U.S. academic institutions are naturalized citizens. (Figure)

Women comprise between 15% to 25% of faculty. The most selective AND the least selective institutions have the highest average percentages. (Figure)

Minorities comprise fewer than 10% of all doctoral faculty. Their percentages ranges from less than 5% at the most selective liberal arts colleges to 13% in the least selective comprehensive education institutions.

Age

The average age of doctoral faculty has increased steadily since 1973. This is primarily the result of hiring and tenure practices of the 1960s. Further aging of the faculty stock can be expected to continue through the mid-1990s.

In 1975: modal age: 33, mean age: 43
in 1987, modal age: 46, mean age: 47

The age distributions show a shift in modal age toward the mid-40s, but also reveal differences in the hiring practices of different classes of doctoral institutions; the more selective ones have hired proportionately more young faculty than the others.

While there were only slight differences among institutions in 1975, in 1987 the relationship between relative youth of faculty and university selectivity continued to hold. The most selective liberal arts colleges had the youngest faculty. The more selective doctoral institutions also experienced less aging than the rest, suggesting some continuity in the hiring of young faculty members. Average faculty age at the comprehensive colleges rose more rapidly than at the doctoral research universities because their growth was linked most directly to enrollments.

Put another way, the most selective institutions tend to have faculty with a much more balanced age structure than others.

7.6. Expenditures and Costs

Total revenues of academic institutions increased from about $60 billion in 1975 to about $87 billion in 1986 constant dollars.

Costs of UG education after inflation are increasing at a faster rate than the number of undergraduates. Per unit costs have been increasing since 1981, rising from $5,000 per FTE in 1981 to $6250 in 1986.

Both of the principal cost components of UG education (faculty compensation and capital expenditures) have increased considerably over the past decade--personnel by 12%, facilities by 22% on a per-student basis in constant dollars.

The federal government is a relatively minor contributor to academic revenues. Doctoral universities have many nonacademic revenue-producing activities. Government appropriations are the dominant source of revenues at public institutions. Tuition is the most important revenue source at private liberal arts colleges.

The federal contribution to higher education revenues has dropped significantly over the past two decades at all types of institutions. The difference has been made up through increases in tuition, private gifts, and creative financing.

Throughout the period of rapid rise in university revenues, the federal share has decreased by 30%. Had the feds maintained their share, an addition $3.5 billion would have been available--roughly 40% of which would have been spent on instruction.

To keep up with the increasing costs of education and to make up
for the declining federal share, universities changed to strategies defined by their traditional revenue sources. In the early 1980s, states and localities failed to pick up the slack left by the feds. Hence, all colleges were forced to raise tuition, make internal reallocation, or increase funds from other sources.

R&D intensity as measured by R&D dollars spent per UG falls off sharply through the doctoral institutions to very small amounts for education institutions. This reflects the research focus of the large doctoral institutions, and the more single education-oriented approach of the other institutions.

Average R&D spending is highly correlated with the average NRC scholarly quality of institution’s graduate faculty.

Large differences are evident in spending growth. Private doctoral spending growth for research and education is balanced—50% each over decade. Public doctoral Doc1 is balanced, but for Doc2s, 75% for R&D, for Doc3s, 85% for R&D. This growth was spurred by nonfederal funds (suggesting that the lesser doctoral institutions were indeed reallocating funds from teaching to research).

The public doctoral’s R&D growth exceeded that of any of their private counterparts; conversely, their growth of education spending lagged behind (Doc2 and Doc3).

Annual education expenditures per student are 20% higher at Ed than at Doc institutions. Increases in per student spending were highest for private institutions (30%) and lowest for public colleges. As a group, private education colleges spent 55% more per student than public research universities.

There is no consistent pattern in the capital/operating ratios for different classes of schools. The most selective liberal arts colleges consistently spend a relatively larger portion of their budgets on capital.

Operating funds have accounted for 90%+ of total spending of colleges and universities and rose by 45% during the decade. In contrast, FTE enrollment has risen by only 10% over the same period.

Education expenditures represent 80% of total spending at Ed, 45% at research universities.

7.7. Teaching vs. Research

Next to college curriculum, no aspect of university education has provoked more complaints that the faculty's preoccupation with research at the expense of teaching.

It is widely believed that institutions slight their students when they emphasize research in making appointments and refuse to promote unproductive professors even though they are highly successful classroom teachers.

Those who speak up for teaching tend to dismiss research with hardly a word about the reasons that have led society to devote so many billions of dollars to its pursuit.

Little is said about its importance to society or its potential benefits for teaching.

Instead critics condemn the bulk of scholarly activity either as a serile product of requirements imposed by philistine administrators or as a form of private pleasure that selfish professions enjoy at the expense of their students.

There are very strong incentives as well as needs for research...visibility, reputation, etc.
The critical questions is whether universities are doing what they can to develop incentives and rewards for good teaching that will help to restore a healthier balance between teaching and research. Contrary to popular opinion, the proper remedy is NOT to promote popular teachers who are undistinguished scholars. A vital part of a professor’s job in a research university is to expand knowledge and train graduate students. Neither task is likely to be done well by individuals who have failed to show real talent for research by the time they reach the point of tenure. Besides, professors who publish little are unlikely to thrive in the atmosphere of a research university and often have less to communicate and less enthusiasm for doing so as time goes on.

8. What Actions Have Been Suggested?

8.1. Changes in the nature of the research university:

Perhaps faculty should separate their teaching functions from their research responsibilities.

Perhaps universities will have to choose between playing a key role in our nation’s research enterprise and their traditional educational functions.

Perhaps we should re-examine who determines the research agenda for our universities.

8.2. Changes in the faculty culture:

Create a climate that favors teaching (e.g., hiring, promotion, tenure, salary criteria)

Emphasize that all faculty are expected to be involved in teaching (e.g., teaching responsibilities are “non-negotiable”)

Foster a more systematic effort to evaluate teaching and implement steps to improve it.

8.3. Possible NSF Actions:

Present NSF policies

Important that NSF research policies actively encourage rather than passively discourage attention to teaching by the researchers NSF supports

Research with students is clearly part of the teaching function at the graduate level and is or should be becoming increasingly so at the UG level.

Excessive use of postdocs in research is just as bad as excessive use of GSTAs in undergraduate teaching.

Concern about overwhelming pressure now placed on beginning faculty as well as established faculty researchers to obtain support for a significant portion of their academic year salary from research grants can cause great distortion in their choice of research directions.

Proposals by the faculty and research performed by their students reflects primarily the amount of money available rather than the scientific value.

Excessive pressure to obtain funding absorbs enormous amounts of faculty time and pushes the teaching function into a secondary role.

Renewal proposals should be judged in large measure by the output of well educated and highly qualified graduate students.

Helpful also would be a limitation on the fractional percentage of funds permitted for postdocs for an academic program at a university.
The drive for the highest level of research productivity not only leads to the avoidance of formal teaching at any level, it often biases research teams to prefer postdocs to inexperienced graduate students who need so much informal instruction and nurturing...not to mention tuition.

What can NSF do?

NSF sets the tone for basic research support. Hence NSF should be an integral part of the process of improvement of education at both the UG and graduate level...otherwise teaching will be thought of as an inferior activity instead of as the natural key accompaniment to research in a college or university setting.

Perhaps NSF should experiment with a variety of approaches to involve the research community in the improvement of education and to discourage the cultural trends that are so disturbing.

Should we attempt to reach a consensus on whether or not NSF should attempt to intervene explicitly on this cultural issue to counter the effect now implicit in NSF policies.

Examples of interventions:

i) Require each PYI to teach a one semester UG course each year, a one semester grad course, and serve as the research advisor for 2 graduate students as a minimum on average over 3 to 5 years.

ii) Could also have a minimum educational commitment to instruction and the guidance of graduate students of PIs.

iii) Might also encourage increased instructional participation by giving preference to instructional proposals by highly qualified research, in an effort to send the strongest possible signal that research and education are an integrated whole in the view of NSF.

An appropriation fraction of total support channeled directly to the better graduate students by means of sizable grants given through departments would help to produce an environment where the scientific challenge of the research program would be the attraction to the better students rather than the availability of larger amounts of funding from one agency or another for one purpose or another.

Proposal requirements (actions already taken)

A statement specifying the potential of the proposed research to contribute to education at the postdoctoral, graduate, and especially undergraduate levels.

A list of graduate students and postdoctoral scholars with whom the PI has had an association over the past five years.

Limits on the number of publications listed in the CV (10)

More strategic actions

Conduct studies to determine the impact of research on the quality of undergraduate education in science and engineering.

Determine what the impact of past and present NSF research policies have been on university teaching
The most important thing the NSF can do for science education is to increase the prestige and respectability of teaching. The worth of a faculty member is often judged by his or her success in the competitive process of seeking research grants. A national competitive process for seeking funds for innovative teaching and curriculum improvement would also give young faculty visibility and credit in the tenure process.

Develop national awards for outstanding teaching:
- Presidential Young Teaching Awards
- Presidential Science Teacher-Scholar Awards
- NSF Medal of Excellence in teaching
- NSF Distinguished Professor

Modify the way in which graduate students are recruited, trained, and funded to enhance their teaching:
- NSF Graduate Teaching Fellowships
- NSF Postdoctoral Teaching Fellowships
- Teaching Assistant Training Workshops

Alter NSF programs to include an emphasis on the commitment to combined teaching and research:
- Include UG teaching requirements for PYIs
- Include UG teaching requirements for PIs
- Give grant award preference to instructional content

Important that NSF research policies actively encourage rather than passively discourage attention to teaching by the researchers NSF supports

Examples of interventions:
- i) Require each PYI to teach a one semester UG course each year, a one semester grad course, and serve as the research advisor for 2 graduate students as a minimum on average over 3 to 5 years.
- ii) Could also have a minimum educational commitment to instruction and the guidance of graduate students of PIs.
- iii) Might also encourage increased instructional participation by giving preference to instructional proposals by highly qualified research, in an effort to send the strongest possible signal that research and education are an integrated whole in the view of NSF.

8.4. A More Positive Approach

How do we take advantage of extraordinary learning environment offered by the research university?

Research universities can and should play a very unique role in undergraduate education:
- (1) We should provide our undergraduates with an experience which draws on the vast intellectual resources of the modern research university: its scholars, its libraries and museums, its laboratories, its professional schools, its remarkable diversity of people, ideas, and endeavors.
- (2) We should expose our students to the excitement
of great minds struggling to extend the bounds of knowledge. Of course we recognize that the scholars we place in the classroom may not always be the best teachers of knowledge in the traditional sense. But research universities benefit from the presence of a cadre of excellent, stimulating teachers, and we are convinced that only by drawing into the classrooms faculty with strong commitments to scholarship can we stimulate our students to develop the skill at inquiry across the broad range of scholarly disciplines that is so essential to life in an age of rapidly expanding knowledge.

(3) We should develop in our students both the ability and will to strive for knowledge. We believe that a critical component of an undergraduate education in a research university is the development of the will to seek and the skill to find.

(4) We should expose our students to the diversity, the complexity, the pluralism of peoples, cultures, races, and ideas that can only be found in the intellectual melting pot of the modern research university.

(5) And we must also accept our mission to educate the leaders of American society. Indeed, if past experience is any guide most of the leaders of this nation will continue to be produced by our great research universities.

9. The Nature of the University College

9.1. Definitions

Different students benefit from different education settings. Small liberal arts colleges provide the most congenial learning environment for some, others blossom at community colleges, and many thrive at major research institutions.

Lib Arts Colleges
Faculty does less research. Elementary presentations of an academic subject change slowly, and the pressure to remain up to date and to understand the frontiers of a subject is weaker. In colleges, the setting in which instruction takes place is intimate: small faculty, small classes, small student body. Concerns about personality are magnified. This yields teaching faculties of great competence, strongly motivated to help and support the undergraduate. However there is little opportunity for instruction in lib arts colleges to rise above the elementary or intermediate level.

University College
University triad:
Oldest of responsibilities is educatoin of UG students. Other two legs of triad--the educatoin of graduate students and a large-scale commitment to scholarship and research--are, respectively, 19th and 20th century addition.

The college within the university, in which a selected group of undergraduates works within and among a challenging array of activities in scholarship and advanced education, offers a unique set of opportunities. University colleges are the most exciting
of all alternatives for those students able to handle the challenge.
University professor is a different breed of cat. He teaches UGs and graduates...
Universities are large, busy places. Faculty range is very wide...clinicians, layers, architects mingle with scientists, economics, and philosophers...What matters greatly is the need or opportunity to coexist with a graduate school, the training ground of future generations of scholars.

9.2. **Fundamental Premise of University College:**
The distinguishing characteristic of the research university is the research and scholarly activities of its faculty, staff, and students.

1) Teaching and research support one another. Research cultivates the critical skills needed to work from problem to solution, to sort out errors, and to pursue a single line of inquiry to a satisfactory end. Indeed, the fact that some of our finest scholars and scientists are demonstrably outstanding teachers underscores the compatibility and mutual support of these primary faculty activities.

2) Leaders in basic and applied research, who are engaged in defining and expanding the scope of human knowledge, provide an atmosphere that is diffused throughout the entire student body. Through role model and mentor relationships, these faculty members stimulate their students, motivating them to more intensive study.

3) Active scholars are in the best position to incorporate the most recent discoveries and developments in their field into undergraduate courses.

4) Undergraduate education at research institutions is further enriched by a constant flow of people and ideas from outside the university.

5) Research universities offer their undergraduates a vast range of options for specialized study.

7) The quality of undergraduate education on our campuses is further enhanced by the contributions of our graduate students. Some of the very best one-on-one teaching in our classrooms and laboratories comes from these apprentice scholars and scientists, as the enthusiasm and excitement of their own study and research carry over into their teaching.

8) The undergraduate experience at a research university benefits from the resources maintained primarily to support faculty research and graduate education. These essential underpinnings of the research mission on our campuses include a wealth of libraries, laboratories, computers, and other equipment and facilities. To have firsthand experience with a laser beam generator, to perform in a completely equipped theatre, or to hold and read a 300-year-old book may not be indispensable to an undergraduate education, but they enrich it beyond measure.

Top university colleges share the strong and sometimes controversial belief that research and teaching are complementary activities;

Combination of teaching and research is part of the university faculty identify.
We believe there are no unresolvable conflicts among research, graduate education, and undergraduate education. We believe that the tensions produced by the sometimes competing demands of each, when managed constructively, produce intellectual work of the very highest order and that research universities are actually very good places for the education of undergraduates. We believe an UG education at a major research university offers important advantages and adds value that cannot be obtained elsewhere.

9.3. **Advantages of a Research Faculty**

The college within the university, in which a selected group of undergraduates works within and among a challenging array of activities in scholarship and advanced education, offers a unique set of opportunities. Faculty members in such places are familiar with the boundaries of human knowledge and often can involve UG students in their searches. The wealth of specialized research centers, institutes, and professional schools constitutes a reservoir of opportunity that able students frequently tap. It should be possible to broaden and facilitate that kind of contact, so that the potential of the research university for UG teaching is enhanced. The university professor is not a teacher who is expected to confine himself to the transmission of received knowledge to generations of students. He is assumed to be a PRODUCER of new knowledge, frequently with the assistance of apprentice graduate students, who transmit state-of-the-art knowledge to students at all levels.

Why would an UG want a research-oriented teacher?

i) Research is an expression of faith in the possibility of progress...a form of optimism about the human condition. Persons who have faith in progress and therefore possess an intellectually optimistic disposition are probably more interesting and better professors. They are less likely to present their subjects in excessively cynical or reactionary terms.

ii) By far the healthiest and most efficient methods of fighting burnout is research. A research-oriented faculty is less likely to be the home of intellectual deadwood. Active, lively, thoroughly current minds that enjoy debate and controversy make better teachers.

iii) It is difficult to evaluate the quality of teaching, it is far easier to evaluate the quality of research, and to base faculty selection primarily on research performance to lead to fewer mistakes. Both teaching and research should be taken into account, but research ability is a better long-term indicator.

iv) Besides teaching, the university professor does much else, writing, consulting, testifying, etc....but this can enliven teaching.

9.4. **Advantages of a Research Environment**

The human and physical resources that place it at the forefront of advancing knowledge make the research university uniquely capable of offering the kind of education that will prepare today's undergraduates for the rapidly changing knowledge-intensive world in which they will live. At their best, university colleges are among the most
exciting places on earth. Their professors have written the book at people talk about; they have engaged in public controversies and have held vital public post. They are at the center of the action. Further, in leading university colleges, student bodies are national and international in scope. They are also contentious and accomplished, mirroring the faculty in the diversity of its interests and the range of political and social views. This is important since students learn a great deal from each other.

A distinguishing feature of university life is the presence of graduate students. Sometimes you hear the familiar refrain that while big names and famous professors are at top universities, most UG contact will be with graduate teaching assistants; callow and inexperienced youths, not infrequently foreigners who can barely speak English. Rosovsky notes three of his TAs were Henry Kissinger, Zgibniew Brzenzinski, and James Schesinger. Graduate students are more thoroughly familiar with their subject. They are more likely to know the latest techniques and current controversies than their counterparts in the colleges.

We assert that the scope, scale, and diversity of the research university enable it to address and accommodate the educational needs of a very large number of undergraduate students.

9.5. The Advantages of Scale

1) A major university provides its undergraduates the broadest range of curricular and extracurricular offerings. An obvious example is the very large number of foreign languages taught on our campuses, where instruction may be offered in as many as 40 foreign languages. Moreover size makes possible greater flexibility in funding and allocation of other resources, which enables our institutions to adapt themselves more readily to the changing needs of undergraduate education.

2) Large faculties bring a multiplicity of viewpoints to their subjects. Within a single English department, students are likely to find not one specialist in Victorian literature but several; not one but many specialists in the varieties of interpretive theory; not only traditional scholars, but those who bring radically different perspectives to bear on their work.

3) At a major university the student body itself tends to have a greater diversity than is usual at smaller institutions. Most of the elementary and secondary schools from which our students are drawn do not provide them with daily exposure to multiracial, multicultural environments. Students from many foreign countries, and particularly from developing nations, also populate our campuses in substantial numbers.

4) The many international relationships of major research institutions provide valuable experiences and opportunities for undergraduates. In a very real sense our student bodies, faculties, and curricula are internationalized.

5) Special kinds of experiences—honors programs, supplementary learning opportunities, career counseling programs, overseas study programs, and many others—often are possible only
because of the size of the student body.

6) Scale plays a major role in the scope and variety of services and cocurricular opportunities available to our students. The quality of campus life has an undeniable influence on the effectiveness of UG education. Cocurricular learning makes vital contributions to the cultural, emotional, physical, and social development of our students, contributing in significant ways to the total personal and intellectual growth of the undergraduate. Community is fostered at institutions like ours within residence halls, organized Greek units, and a myriad of off-campus housing arrangements.

9.6. What we are...and what we are not!...
UM is not a small liberal arts college...

It is a great research university.

It is a very large, complex, and exciting place.

To give you a sense of this, consider the following...

Parameters:
  Enrollment: 35,000 (Ann Arbor) (47,000 total)
  Faculty: 2,600 (14,000 employees)
  Budget: $1.5 billion

Academic Units
  17 Schools and Colleges
  Hundreds of research centers, institutes, and other types of interdisciplinary programs

We also run the largest health care system in the Midwest, treating over 750,000 patients each year...

We conduct events in the performing arts which rival New York and London...

whether it be Leonard Bernstein performing his 70th birthday concern with the Vienna Philaharmonic or, God-forbid, the Grateful Dead....

And, speaking of entertainment, we also have the Bo and Steve show...the Michigan Wolverines...

Or, in the winter and spring, to every household in America...

...at least if we make the Final Four....

Mission:
  i) Provides instruction, research, service
  ii) Spans all intellectual disciplines and professional areas
  iii) Attempts to sustain programs that rank among the nation's best in all areas (and succeeds...)

On this campus, we provide one of the most incredible intellectual smorgasbords in the world--a fascinating cornocopia of ideas supported by some of the finest facilities in the world -- one of the nation's great libraries, museums, laboratories, computers, concert halls, athletic facilities -- and most important, one of the world's great faculties.

What is unique about our universities?

What is our "market niche"?

Well, we are all large, comprehensive, public, research universities.

We all share a serious commitment to scholarship as well as a commitment to unusual breadth across a rich diversity of academic disciplines,
professional schools, and social and cultural activities. We have all achieved an unusual degree of pluralism in our students, faculty, and staff. Our campuses demonstrate an unusual degree of participation of faculty and students in the university decision process. And we all share in an unusually strong commitment to the quality of our students, our faculty, and our programs. In a sense, the strength of our institutions depends upon our efforts to achieve an optimum blend of quality, breadth, and scale. We attempt to do a great many things, to involve and benefit a great many people, and we attempt to do everything very well. Furthermore, we attempt to achieve a balance among teaching, research, and service, as well as undergraduate education, graduate education, professional education, and faculty scholarship and development. It is important to note that we do not view achieving this balance as a conflict between competing goals. Rather we view it as an opportunity to exploit an important creative tension. It is this blend of missions which provides our research universities with such a unique environment for undergraduate education. We are not--nor should we try to imitate--a small liberal arts college, with a faculty chosen primarily for their teaching skills, and with a curriculum limited both by design and resources. Rather, we are a large, comprehensive university, spanning almost every intellectual discipline and profession. We have the capacity to attract and sustain many of the world's leading scholars. We provide intellectual resources unmatched elsewhere in our society, whether in the extent of our library and museum collections, or in the laboratory facilities we provide, or in the exotic new tools of our intellectual trades ranging from supercomputers, to the sophisticated equipment required for solid state electronics and recombinant DNA research, to the expensive instrumentation used for positron emission tomography in our medical centers. Our philosophy is to use these extraordinary resources not simply to teach facts...indeed, students of your ability can learn facts, content, pretty much on your own. Furthermore, in many fields, the knowledge base is doubling every five years...hence an undergraduate education only serves as the stepping stone to a process of lifelong education. Moreover, save for the most basic information, it is no longer necessary at the college level to commit vast amounts of knowledge to memory. Indeed, we now live in a world where knowledge and information can literally be plucked out of the air...or off your computer terminal. Hence, of more lasting value are the broadly applicable skills and wide-ranging perspective that is characteristic of a liberal education. Thus our goal is to expose our students to the world's leading scholars, people who are struggling every day with creating new knowledge and interpreting and transmitted the accumulated knowledge of the past. Our goal is to teach methods of inquiry...methods of
critical analysis and thought...and beyond that, to expose you to the most fundamental of human values which are essential to our civilization.

This style of education can be frustrating at times, but we are convinced as are the other great research universities of this nation...that our students will be far better prepared to assume the role of leadership in society with this type of an education.

But rather, a college education is a time of challenge and discovery, of curiosity and intellectual growth, of learning about yourself. It is a time to learn the art of life...

From this perspective, it is critical that to realize that our students probably learn more OUTSIDE of the classroom than in it!

This University is designed to provide a rich environment of intellectual experiences... Whether it be through the wealth of formal instruction we provide, or through the array of cultural, social, athletic activities.

In fact, I suspect that most of you will end up learning more from your interaction with other students than you will from faculty!

A Michigan education is not designed to be a passive process. While our students probably have more opportunities to learn on this campus than any other university in the nation, it is also true that these opportunities are not presented to them on a silver platter.

We expect them to play an active role in their education! To explore, to discover, even to challenge themselves. After all, life is one of those do-it-yourself experiences...

As the saying goes...

"At Michigan you will be given unusual freedom and responsibility...

The freedom to do what you want...

And the responsibility to choose the right things..."

Real advantage of our institutions is linkage between different levels and types of learning--also diversity of approaches, different strokes for different folks.

"We need new approaches to UG education that are less focused on the transmission of knowledge and more sensitive to the need to infuse students with both the excitement of discovery and a capacity for analysis and continued learning. This may require that faculty separate their teaching functions from their research responsibilities." (Harold Shapiro, Princeton)

However, although we lack a theory of the speed of scholarly progress, I would not be surprised in productivity were proportional to the access time to information. If this is true, the computer and associated technologies are about to transform the world of scholarship in a way that can only be guessed at. (HTS)

10. Final Comments

10.1. It is clear that America's highly decentralized system of 3,500 institutions accomplishes these goals far better than the government-controlled systems that predominate in the rest of the world.

10.2. Different segments of higher education pursue these objectives in different ways. Research
universities contribute to all of the ends above.

10.3. **Unless we are prepared to recommend another**
    system, it makes little sense to condemn
    the one we have for shortcomings intrinsic to
    its very nature.

10.4. **In all advanced societies, our future depends to an ever**
    increasing extent on new discoveries, expert
    knowledge, and highly trained people. Like it or not,
    universities are our principal source of all three
    ingredients.

10.5. **While American research university is clearly the envy**
    of the rest of the world, its unique character and role
    are clearly neither understood nor appreciated by
    the American public at large--or by most of their
    elected public leaders.

10.6. **Perhaps we need a better term...**
    Not “research universities”...
    ...but “learning universities”...

10.7. **A story:**
    When questioned whether Michigan is a “teaching”
    or a “research” university, we should answer...
    ...we prefer to think of it as a “learning”
    university.