

THE STATE OF RESEARCH ENDEAVORS:

VIEW FROM THE UNIVERSITY-WIDE LEADERSHIP LEVEL

KNOWLEDGE FOLLOWS INQUIRY, WISDOM FOLLOWS DISCOVERY

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I recently visited Japan where I spent much time talking to officials in the Japanese Ministry of Education. The Japanese have embarked upon a \$50 billion investment in university research--a segment of the Japanese university under-funded for years. Although Japanese industry has become the world's leader in transferring technology to the marketplace, Japan has concluded that without a continuing source of basic research they will eventually have little technology to transfer. Investment in technology has made Japan the world's leader in finding applications for research developed elsewhere, but such shrewd adaptation will not be sufficient to compete in a world economy increasingly driven by new discoveries about the very nature of the Universe. In short, Japan has decided to make a major investment in the kind of basic research routinely expected from American research universities.

What is the lesson here? On a practical level, we should be aware that Japanese intellectual skill and capacity for planning will present a formidable challenge for world leadership in research. We should be concerned about our own funding cutbacks in basic research and its impact on our future economy. Japan's actions, however, affirm the basic wisdom of the American research system. The U.S. has assigned responsibility for basic research to the American university, particularly in the post-World War II era. As a result, university discoveries in medicine, agriculture, biotechnology, polymer science, and computing have dramatically improved the American economy, health care, telecommunications, and general quality of life.

In contrast to Japan, where research heretofore has been primarily a part of industrial planning, or to many European countries, where research is funded in government operated academies or institutes, most basic research in the United States has been wedded to the educational process. Beginning during the Second World War when university scientists helped win the war by developing atomic energy and microwave radar, continuing after the war with the "federal research compact" which funded university research through NSF, NIH and other government agencies, an elite group of 150 or so research universities--including the University of Kansas--accepted responsibility for a dual mission in modern American society. The research universities' mission has been to conduct the basic research necessary to expand the economy and maintain world leadership, and at the same time, and with the same faculty, educate the next generation of scholars, thinkers, and scientists.

The genius of this "research compact" is that basic research in the U.S. has been institutionally tied to education. The terms "research and graduate studies," for example, are virtually synonymous in American higher education. University vice presidents are often given

the “research and graduate studies” portfolio. “Research assistants” are not laboratory technicians but students studying for a graduate degree. “Teaching assistants” are those students “doing research” for a graduate degree while simultaneously developing and demonstrating teaching skills. “Earning” a Ph.D., the degree symbolizing the highest level of education, is the compensation for conducting research.

This identification has shaped the modern American university. We believe as an article of faith that research is the medium for learning. Faculty assign and students write “research papers.” University libraries rank themselves as “research libraries,” a category which distinguishes them from all but a few “public libraries.” Research may take place in the “public library” through the individual acts of inquiring citizens, but these acts occur outside the context of “sponsored research” conducted by university faculty “training” graduate students.

The American research university expresses the motto: knowledge follows inquiry, wisdom follows discovery. Research and education have become cause and effect. One “does research” in order to “become educated,” whether we are talking about the graduate or undergraduate level. The distinction between graduate study and undergraduate study is sometimes judged by the amount of new knowledge generated by the research process. The graduate student’s research is expected to contribute new knowledge to the field. The undergraduate’s research usually contributes new knowledge to the individual.

When one sums it up, one realizes that the American research university has become both the voice of research and the exemplum for its benefits to the educational process. Universities pride themselves on the number of Nobel Prize winners on their faculties, not simply because their labs produce the best science, but also because their very presence indicates “education” of the highest order. If Nobel-level learning takes place on that campus, by inference it must be a good place for all levels of learning. The causative circle of research to education, education to research, is presumed to characterize the entire place.

Society depends on the university to validate research, and the university benefits from its identity as a place where research shapes education. Given this dynamic, it is surprising to note how universities have sometimes failed to defend their dual mission of research and education. Too often in the recent past, the university has permitted research to be cast as the enemy of education. The irony of this failure is overwhelming--the university as voice and example of research failing to defend its own fundamental interests. Yet the American research university has engaged in a number of practices which have sometimes undermined research in the popular mind and separated it from education, at the very moment that its faculty was conducting activities such as discovering a cure for polio or revolutionizing the fields of modern chemistry and modern biology.

I see four ways that the research university has permitted research to be interpreted as the enemy of education. Perhaps if we understand how we have acted counter-productively, we can more readily fulfill our dual mission, and reaffirm the “research compact” which has meant so much to American society over the past half-century.

First, research universities neglected undergraduate education in the sixties and seventies, and as a result encouraged a dangerous debate between research and teaching. Although the last 15 years have seen a remarkable reform in undergraduate education, the terms of the original debate are still very much with us. Seized upon and distorted by the popular press, this debate between research and teaching led to the demonizing of university research faculty. Supposedly, selfish research scholars driven by the Faustian demands of their discipline rejected the simplistic questions of undergraduates, taught seldom, buried themselves in libraries or laboratories, spent lavishly on travel to foreign conferences, avoided callow freshmen and thereby destroyed the university's delicate "balance" between research and teaching. On most campuses this caricature was just that--more myth than reality. But there was just enough truth to the exaggeration to give popularity to this cartoon view of the research scholar.

This emphasis upon the individual faculty member has drawn our attention away from the mischief in the misplaced metaphor. The figure of a "balance" between research and teaching is fundamentally wrong. Teaching and research are not balanced on a fulcrum, nor are they part of a zero-sum game. They are causally linked. Neither can take place without the other. Without the knowledge generated by research, the teacher has nothing to teach. Without the discovery generated by the student's research, the student fails to learn. Without learning, there can be no wisdom. Research universities have largely failed to explain this causal circle between education and research, research and education. The idea of "balance" erroneously suggests that education is only a function of faculty time allocated to teaching. Rather than participate in such a debate, we would be better served to institutionalize our belief that the process of learning at all levels grows from the desire to know, a state of being only attainable through the act of inquiry. We should ask whether our curriculum, graduate or undergraduate, is truly structured around research.

Secondly, the current over-supply of Ph.D.s in many disciplines has called into question the economic consequences of educating graduate students without reference to the labor market they will enter. In both the sciences and the humanities, graduate students are disaffected, feeling betrayed that the consequences of pursuing intellectual interests to the highest professional level, and developing research skills of great sophistication, educates one out of a competitive labor market. The specialized learning which characterizes traditional Ph.D. programs proves not to be in much demand in an educational marketplace where universities are caught in a price-cost squeeze and federal and local governments are intent on shrinking the size of government expenditures.

In the future, programs will have to be more selective in their graduate admissions, more cautious about the size of their enrollments, less myopic about the practical consequences of educating "degree seekers" for nonexistent jobs, and more supportive of students seeking a venue for their training outside the academy. Nothing will call into question the value of research more quickly than a free market economy which seems to have no role for the human products of the research university.

In my own opinion, we are entering a decade where university graduate programs will need to have higher standards and less of a vocational purpose. They will be judged not by their size, but by their quality. Admission to the best programs will become more akin to admissions

to law school and medical school, and the program itself will be more a way of thinking, less a preparation for a career. Further, only the best programs will survive in an era of reduced funding.

Third, research universities have failed research by neglecting the responsibility for scientific literacy in the general public. As an advanced scientific society which sends probes to Mars, implants electrodes in Parkinson's patients' brains, and discovers the basic proteins of the human cell, our democratic way of life is threatened if we fail to understand complicated science. A democratic citizenry must comprehend science to make informed judgements about public policy. Yet many Americans, including many graduates of our research universities, have little understanding of science or the research that leads to scientific discovery. The National Science Foundation reports that only one in nine Americans feels well informed about science and technology, fewer than one in ten can explain a molecule, and only 2 in 10 understand that DNA is a molecule that contains the genetic information for each cell. Only 5% of the population can explain acid rain. What people do believe is that science and technology make their lives better-- 3 out of 4 have such a faith.

Fourth, universities have failed research by teaching science as though it were textbook memorization rather than active inquiry. Science in research universities is usually taught in a large introductory course, often without a lab. Too often, nonscience students find these experiences so unsatisfactory that they become science-averse for the rest of their lives. As Sheila Tobias and other analysts of this experience have pointed out, we lose early the interest of many of those who will eventually shape public opinions about research. We leave students with the impression that the complexities of science defy explanation. Science is a black box mystery which has all the characteristics of magic. Making matters even worse, the ability to disseminate pseudo-science or pseudo-research has become widespread with the growth of global Internet systems. Not only are complex research problems difficult to explain, but simplistic explanations of virtually everything abound. Just as "Black helicopters" reduce the complexities of international relations to a simple paranoia, so also does folklore about simulated space landings in New Mexico exempt people from mastering the science needed to understand a Mars rover. We have been too timid in reacting to such folklore, whether it is called "creationism" or "Star Wars," and we have not done enough to orient our curriculum around the act of discovery.

Research universities should restructure the curriculum in order to put greater emphasis upon research methods. If we really believe in the causal link between research and education, then we should embed the discovery process into our undergraduate, as well as our graduate, curriculum. We can ill afford to graduate students who think science is magic and research is for nerds. We graduate too many undergraduates who have not experienced firsthand the hard work of research and the joys of discovery. If we consciously built research into the curriculum, at every level, Freshmen to Ph.D., our universities would look different, and our public would better understand how our research contributes directly to our educational mission. (We would also have many more faculty than we have now, because research requires the personal interaction of mentor and student.) What if no introductory courses--in any discipline--were designed simply to disseminate basic knowledge in the field? What if every senior were required to complete a research project, and supplied with the money to build the apparatus, access the data base, or visit the special library necessary to complete it? There are few research

universities in the country which can feel proud of the size of their investment in undergraduate research, especially when compared to its investment in research generally.

The university does not bear the sole responsibility for public misconceptions of scientific research, nor the sole responsibility to explain research, but I do believe the university is positioned--given its pool of intellectual talent and its stake in the outcome--to play a major role in reaffirming the causal link between research and education that lies at the very heart of the Federal research compact. That compact has served the country well by ensuring that more than half the basic research in the U. S. takes place at institutions of higher education. It has also enabled the American system of higher education to become the most admired and most powerful in the world. It is the reason Japan is changing its system to emulate the American university, and it is the reason that all of the world wants to study at an American research university.

If we at such universities want to preserve our dual mission, and our international dominance, we probably cannot depend on anyone else to communicate why the research university is so central to American success in the 21st century. The next century will find many nations challenging our global leadership and intellectual resources. We should recognize the coming challenge and begin the planning to preserve our unique status.