# Merging Research with Service and Teaching in an Engineering Technology Department

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## ABSTRACT

When asked for a definition of research, engineering and engineering technology faculty usually respond with definitions that describe the technical and scientific projects they have been involved with. This type of research usually falls under the *scholarship of discovery*. Consequently, research activities are segregated from the other activities faculty are called upon to do, namely service and teaching. Engineering and technology faculty are often unaware of the broader definition of research offered by Ernest L. Boyer in his text, Scholarship Reconsidered. Many universities are adopting this expanded view of research. At The University of Memphis, teaching-faculty are encouraged to share their experience in the classroom through the *scholarship of teaching.* Technology faculty are joining in the research arena by sharing their technical experience through the *scholarship of application* and the *scholarship of integration.* This paper presents, as an example of the expanded definition of research, one engineering technology faculty member's efforts to develop a research plan based upon teaching and service.

## INTRODUCTION:

In his book, Scholarship Reconsidered, Ernest Boyer examines the history of scholarship in American Universities, as well as proposing an expanded definition of scholarship.[1] An understanding of the historical development of the academic profession is valuable to educators and administrators as they attempt to deal with many of the dilemmas facing higher education today. There is much discussion about the research and publication requirements for tenure and promotion and how they appear to be diametrically opposed to teaching and service. Boyer claims that it is time for America's colleges and universities to clarify their missions and to relate the work of the academy more directly to the realities of contemporary life. To accomplish this, a new vision of scholarship must be developed. This new vision of scholarship will strengthen diversity within the university by enabling the faculty to more effectively utilize their individual talents and bring renewed energy to the classroom.

The history of scholarship in American academia can be divided into three phases. The first phase begins around 1636 with Harvard College which followed the colonial college tradition whereby the mission was to provide a continuous supply of learned clergy who would bring redemptive light to all mankind. Teaching was considered a calling, much like the ministry, and according to Theodore Benditt, "professors were hired not for their scholarly ability or achievement but for their religious commitment. Scholarly achievement was not a high priority, either for professors or students."[2]

The second phase corresponded with the industrial revolution. Applied research was born when it was realized that professors could spread knowledge that would improve agriculture

and manufacturing. Rensselaer Polytechnic Institute was established in 1824 and according to Frederick Rudolf was a "constant reminder that the United States needed railroad-builders, bridge-builders, and builders of all kinds, and was prepared to create them even if the old institutions were not."[3] In 1846 Yale University established the professorship of "agricultural chemistry and animal and vegetable physiology." The movement was further strengthened by the Land Grant College Act of 1862 whereby the federal government gave land to each state in support of both education in liberal arts and training in the skills that ultimately would support the emerging agricultural and mechanical revolutions. The Hatch Act of 1887 added fuel to the effort by providing federal funds to create university-sponsored agricultural experiment stations that brought knowledge to the farmer. American higher education which was once devoted primarily to the intellectual and moral development of students, added service as a mission, and the public university was born.

Gradually the mission of the university changed from serving the religious needs of society to attempting to reshape it. The idea of higher education as a democratic function to serve the common good was embodied in the university system. It was believed that graduates would ultimately fill the legislature, staff newspapers, municipal and court boards and corruption would come to an end. While professors were called upon to apply knowledge to solve practical problems, today's version of scientific research had not yet taken hold. Dael Wolfle wrote, "Professors were hired to teach the science that was already known - to add to that knowledge was not expected..."[4] Most of the scientific research was being done by private individuals such as Nathaniel Bowditch in mathematics, John and William Bartram in botany, and Maria Mitchell in astronomy. It was not until the late nineteenth century that the model for the modern university developed. The modern university was modeled after the German approach to scholarship.[5] The advancement of knowledge through research was beginning to take hold and graduate education was emphasized at schools such as, Harvard's Lawrence Scientific School, Yale's Sheffield Scientific School, the Massachusetts Institute of Technology, the University of Pennsylvania, Columbia, Princeton, the University of Chicago, and Johns Hopkins University. Academics were moving from faith in authority to reliance on scientific rationality.

The third phase of scholarship in America began in the 1940's when many of these research universities volunteered to join forces with the government to fight the war. The Office of Scientific Research and Development was formed in 1940 and monetary support began to flow from the government to universities.[6] Higher education and government had, through scientific collaboration, changed the course of history and the marriage has matured with time. In 1947 Harry S. Truman appointed a President's Commission on Higher Education and almost overnight the mission of higher education in the nation was dramatically redefined. The commission stated, "America's colleges and universities should no longer be merely the instrument for producing an intellectual elite. Higher education must become the means by which every citizen, youth, and adult is enabled and encouraged to carry his education, formal and informal, as far as his native capacities permit."[7] At the same time that scientific research was being emphasized and undergraduate teaching de-emphasized in the nation's universities, the student population shifted from a small privileged group to the general populace. This shift was fueled by the GI Bill of Rights in 1944. Higher education which was once viewed as a privilege was now viewed as a right. Just as America's higher education institutions were becoming more inclusive, the

culture of the professoriate was becoming more confining. To be tenured or promoted, faculty began to feel that teaching and research had to be treated as totally separate entities with research and publications acquiring the emphasis. There are some that now claim that universities have lost sight of their mission. To this end many universities are beginning to examine faculty roles and rewards with respect to teaching, research and service. Many faculty and administrators are beginning to adopt an expanded definition of scholarship, such as the one proposed by Ernest Boyer.[8] It is time to identify higher education's true customer, (business, industry and government) and product, (graduates and research) and find a way to allocate resources (time and money) efficiently and appropriately.

RESEARCH + TEACHING + SERVICE = SCHOLARSHIP

Traditionally, university professors have been characterized as scholars. This characterization has also held true for religious leaders, lawyers and medical doctors. A scholar is considered a learned individual who passes on his/her knowledge to others through teaching, and works for the betterment of mankind. Unfortunately, since 1940, many university professors have become more closely identified with the more narrow characterization of researcher. It may describe a learned person, or one who seeks knowledge, but does not include the teaching or service component. As a profession we need to ask what value is knowledge, new or otherwise, if it is not passed on to future generations through teaching, or utilized for the betterment of mankind. It is time to put scholarship back into academia.

Ernest L. Boyer concludes that the work of the professoriate has four separate yet overlapping functions. These are: the scholarship of *discovery*; the scholarship of *integration*; the scholarship of *application*; and the scholarship of *teaching*.

The scholarship of *discovery* refers to research which leads to new knowledge. Universities have been placing increased emphasis on this form of research, and as a result the phrase, publish or perish, has become a cliche. "If we take as our measure of accomplishment the number of Nobel Prizes awarded since 1945, United States scientists received 56 percent of the awards in physics, 42 percent in chemistry, and 60 percent in medicine. Prior to the outbreak of the Second World War, American scientists, including those who fled Hitler's Europe, had received only 18 of the 129 prizes in these three areas."[9] While this form of research is vital to engineering, science, and medicine, it is not always compatible with the mission of other departments within a university such as engineering technology. The expanded definition of scholarship, as proposed by Ernest Boyer, provides an avenue for faculty in departments such as engineering technology to pursue their interests and communicate their ideas.

While the scholarship of *discovery* asks the question, "What is to be known, what is yet to be found?", the scholarship of *integration* asks the question, "What do the findings mean?" A person engaged in the scholarship of integration may not be actively collecting his or her own data, but is trying to present existing data in a revealing way, making connections across disciplines and often educating nonspecialists. The scholarship of *application* asks the question, "How can knowledge be responsibly applied to consequential problems? How can it be helpful to individuals as well as institutions?" This is a particularly appropriate avenue for scholarly activity in a department such as engineering technology. Engineering technology emphasizes the

application of existing technology to solve today's and tomorrow's problems. To be considered scholarly, the activity should be tied directly to one's field of knowledge, should require the rigor and accountability traditionally associated with research activities, and should be documented and communicated to others. It is possible to combine a service project with this form of scholarship, but it must be carefully selected and implemented. Serving on a departmental committee may constitute service but does not necessarily qualify as a scholarly activity. For example, one person may serve on a recruiting/retention committee and only participate at the meetings leaving the bulk of the work to others, while another person on the same committee may be utilizing the data collected by this committee as part of a larger outcomes assessment project to be communicated through ASEE.

The scholarship of *teaching* asks the question, "What pedagogical procedures must be developed to effectively bridge the teacher's understanding to the student's learning?" Unfortunately many people view teaching as routine, something almost anyone can do, a given. But if you stop and reflect on the professors you had as an undergraduate you know this is not true. The scholarship of teaching goes beyond the delivery of lecture notes. To be an effective teacher one must not only understand the material content, but must also understand the different ways in which students learn and be able to convey enthusiasm about the power behind the knowledge. The ASEE has for decades supported the scholarship of teaching. "In the end, inspired teaching keeps the flame of scholarship alive. Almost all successful academics give credit to creative teachers - those mentors who defined their work so compellingly that it became, for them, a lifetime challenge. Without the teaching function, the continuity of knowledge will be broken and the store of human knowledge dangerously diminished."[10]

## THE EXPANDED VIEW OF SCHOLARLY ACTIVITY AT THE UNIVERSITY OF MEMPHIS

J. Ivan Legg, Provost, has on numerous occasions spoken about the need for an expanded view of scholarly activity. In 1993 in an address to the 206th National American Chemical Society Meeting he spoke about the need for all faculty to maintain a level of scholarly activity. The nature of involvement is expected to vary significantly among faculty depending upon their commitments and interests, but he has stressed the importance of peer reviewed vehicles of expression to disseminate knowledge and cultivate creativity. "As we expand the dimension of faculty roles that we should recognize, it is essential that we learn to respect each other for the various roles assumed, whether we contribute through classic scholarship or scholarship applied to learning and to the community around us."[11] The University of Memphis has adopted this expanded view of scholarly activity. This vision has permeated through the colleges and departments.

The Faculty Handbook - Section III Policy on Academic Tenure states:

> "2. Faculty Member - a full-time employee who holds academic rank as instructor, assistant professor, associate professor or professor and for purposes of this policy, meets the minimum requirements for eligibility for tenure in Section III and whose responsibilities primarily include instruction, research, scholarly and/or creative activity, and professionally related service."

The Herff College of Engineering re-examined its mission in 1993 and the college mission statement now includes:

> "Mission 2 - Achieve Excellence in Research
> ...Achieve appropriate balance between instruction, research and service/outreach."

The Department of engineering Technology re-examined its goals in 1992 and concluded:

> "Goal 1. To achieve excellence in teaching, community service, and applications-oriented research as each relates to the major areas of study in the Department of Engineering Technology."

The message is clear. There is no longer a debate over teaching vs. research. The professor must be scholarly in every activity undertaken, teaching, research, and service. The various forms of scholarship, (discovery, integration, application and teaching), are all equally valuable to the university and must be respected in their diversity for the rigor they possess.

## DOCUMENTATION OF SCHOLARLY ACTIVITY

There is much debate over how scholarly activity is to be documented. The Department of Engineering Technology accepts the following as acceptable avenues for validation of research activities:

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| Publications: | Professional journals and proceedings |
| | Textbooks and manuals for commercial distribution |
| | Holding of copyrights or patents |
| Presentations: | Critiquing or editing publications |
| | Conference presentations |
| | Invited presentations |
| Proposals: | Funded through the University by an inside source |
| | Funded through the University by an outside source |

Some of these avenues follow a formal peer review process and others do not. The general opinion is that the activity must be open for examination by scholars outside the department. The underlying philosophy is that every faculty member has an obligation to support the profession through scholarly activity, whether it be through excellence in the classroom or in applied research. For example, if a faculty member prides himself or herself on excellence as a teacher, it is their obligation to share that expertise so that others may improve as teachers as well.

America's universities are the best in the world and, if they are to remain that way, faculty must assume the role of scholar.

## SCHOLARSHIP OF TEACHING AND SERVICE

When hired into a tenure-track position in the Department of Engineering Technology, I faced a very challenging task. Like everyone else, to be awarded tenure I would have to demonstrate an ability to perform duties associated with teaching, research and service. Although I expected such a challenge when choosing my career path, I was unprepared for the expectation that I meet the research and service expectations while teaching four courses, per semester, (and associated laboratories without graduate student assistance). The Tennessee Board of Regents regulations assume that teaching one course should consume approximately twenty percent of a faculty member's work week. This left twenty percent of my week for research and service. It soon became obvious that in order to fulfill service and research expectations I was going to have to combine teaching, research and service endeavors into a comprehensive plan of scholarly activity. After examining my background, interests, and resources, I decided to pursue the scholarship of teaching and scholarship of integration.

The following three examples represent the scholarship of teaching: the first involves an outreach activity; the second, a proposal for funding of instruction; and the last, an example of an activity performed in the classroom. During a semester in which I was teaching basic electronics, a fellow faculty member asked if I was willing to get involved in an outreach/service project that would go into a local high school and demonstrate the analogy between Ohm's law for electrical current and Poiseuille's law for laminar fluid flow. I said yes, not only because of the service component for tenure, but I believed I needed to revisit the high school environment to become more intune with our freshmen. After all, it had been twenty-five years since I was in high school and things have changed. This project has lead to a conference paper in the 1994 Annual Conference Proceedings for ASEE, presentations before the Tennessee Academy of Science, and a journal article currently under review. Another opportunity presented itself when I noticed that a faculty member in my department had sole responsibility for writing a proposal to the Society of Manufacturing Engineers, (SME), Education Foundation. SME Education Foundation grants have supported education in manufacturing by providing equipment, software, faculty training, and recruiting activities for decades. I was impressed that he had been successful in obtaining repeated funding, but was surprised to learn that of the five categories for funding, his time restrictions only allowed him to write to one of them, capital equipment. I requested, and was granted, the opportunity to work with my colleague on the three additional funding areas: faculty development, student development, and curriculum development. It proved to be a very successful partnership; this year's award was the largest to date. This award will support educational activities for all four of our majors: manufacturing, electronics, computers and architecture. One last example of my efforts in the scholarship of teaching is an activity performed with a colleague involving a graduate level class on the Taguchi Method of experimental design. Many of the students in this course were business majors who had no experience in a laboratory or manufacturing facility. While the course was traditionally taught lecture style through case studies, and was mathematically intensive, all agreed that these students would benefit from hands-on experience involving designing and implementation of an actual experiment. The design of a trial concrete mix was selected as the topic of the experiment

because it was well suited to controllable variables such as quantity of water, cement, sand and gravel in the mix, and uncontrollable variables such as curing temperature and humidity. The experience was documented and accepted for presentation at the Total Product Development Symposium in 1996. The target audience for this conference consisted of industrial practitioners of the Taguchi Method who were interested in how the method was being taught at the university.

In addition to the scholarship of teaching, I also have an interest in the scholarship of integration as it pertains to outcomes assessment in higher education. The university has been collecting data on students for years and I am very interested in analyzing this data and using it to improve our programs. Having been involved in several activities leading to conference presentations on outcomes assessment in general education, and I have tried to apply those tactics to an engineering technology program. With increased ABET emphasis on measurable goals, I anticipate this activity will grow in importance to the department and lead to a shared interest with other engineering technology departments. I believe that these examples demonstrate that in the environment of an engineering technology department, careful integration of teaching, research, and service activities will enable faculty members to demonstrate scholarly achievement.

## CONCLUSION

The typical faculty member in an engineering technology department does not have the resources to perform scientific research or pursue the scholarship of discovery. To force them into such activities would take away from the department's stated mission to achieve excellence in teaching and applications oriented research. The generally high teaching loads of faculty in engineering technology should not preclude their pursuit of scholarly endeavors. On the contrary, engineering technology faculty are well suited to the scholarship of integration, the scholarship of application, and the scholarship of teaching. These endeavors need to be valued as is the scholarship of discovery in engineering and science. If America's universities recognize the strength they gain from the diversity of their student population and faculty, and they reward faculty for all forms of scholarly activity, they will continue to grow and serve as models for the world of higher education.

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