E-FAST: THE "ENGINEERING FACULTY ACADEMY FOR SCHOLARSHIP IN TEACHING" AT TENNESSEE TECHNOLOGICAL UNIVERSITY

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Abstract *¾Faculty Development and mentoring are critical issues for all universities. It is widely recognized that the quality of the faculty is a limiting factor in the quality of virtually all academic programs. At universities that enjoy regional reputations, it may be difficult to attract new hires from the top group of candidates. A formally structured program for faculty development and mentoring, coupled with wise recruiting strategies, can help a regional university achieve and maintain the highest possible faculty quality. E-FAST (Engineering Faculty Academy for Scholarship in Teaching) is a faculty development and mentoring program that has been designed to work in concert with recruiting efforts to achieve the highest possible faculty quality. In this paper we discuss the history of faculty development and mentoring activities in Engineering programs in the United States, from the total neglect of development and mentoring that characterized the faculty hiring boom after Sputnik, through the current widespread interest in the "Teaching Academy" concept. Generic issues of general interest to Engineering programs that may wish to establish formalized faculty development and mentoring activities are presented.*

Index Terms ¾ faculty development, mentoring untenured faculty, national teaching college, teaching academy

INTRODUCTION

Tennessee Technological University was founded in 1915 as Dixie College, in Cookeville, Tennessee. Cookeville is located at the geographic center of the State of Tennessee, nearly midway between Nashville and Knoxville. The name and focus were changed to Tennessee Polytechnic Institute a few years later. About four decades ago, the current name was adopted to reflect the fact that we had evolved to include diverse educational programs in a College of Agriculture and Human Ecology, a College of Arts & Sciences, a College of Business Administration, a College of Education, a College of Engineering, a Graduate School, and a School of Nursing. We are presently part of the Tennessee Board of Regents System, which includes six universities, 13 community colleges, and 27 technical training centers. See http://www.tbr.state.tn.us/campuses.htm for further information about TBR. About 8,500 students are enrolled in degree programs at the University, and about 20% of these are affiliated with the College of Engineering faculty, either through undergraduate or through graduate curricula. We offer ABET Engineering Accreditation Commission accredited Bachelor's degrees in Chemical Engineering, Computer Engineering, Civil Engineering, Electrical Engineering, Industrial Engineering, and Mechanical Engineering, and we also offer a NAIT accredited Bachelor's degree in Industrial Technology. Through the Graduate School our faculty offer Master of Science degrees in all Engineering Departments, and a College-wide Ph.D. degree as well.

We have historically maintained a very strong regional reputation for the quality of our Engineering programs. Our graduates are recognized for excellence at companies such as the Tennessee Valley Authority (the region's primary producer of electric power), Marshall Space Flight Center (a nearby NASA facility), Sverdrup (a major engineering contractor at the United States Air Force's Arnold Engineering Development Center nearby), Oak Ridge National Laboratories, Saturn, Nissan, and numerous others with operations in our region. Our graduates have also made major contributions at distant facilities in such well known national companies as Boeing, Compaq, Texaco, and too many others to name here. TTU Engineering graduates are known for their strong work ethic, and for their perseverance, enthusiasm, and dedication to excellence in Engineering practice.

We take great pride in the quality of the teaching and learning that goes on in our College. We recognize that the faculty plays a major role in the success of our graduates, and so we view the development and retention of a high quality Engineering faculty as an issue of strategic importance for our long term success. Our salary structure is modest, although this is offset to some extent by our very low cost of living and the fact that we have historically enjoyed freedom from most forms of state and local income taxes. We have limited resources for new faculty "start-up packages." In spite of our regionally limited reputation, our modest salary structure, and our modest start up packages, we have been able to hire and retain excellent faculty. We are now in the process of developing a formal program to assure continued success for our faculty, and we believe that an important component of this is E-FAST, the evolving "Engineering Faculty Academy for Scholarship in Teaching." The goal of E-FAST is to improve the quality of

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learning that takes place in our classes, while improving the effectiveness and efficiency of the preparation for our faculty.

In this paper we present an anecdotal history of engineering faculty mentoring in the United States from WWII until the present. We then discuss the current interest in faculty mentoring, and we include hyperlinks to mentoring programs at several universities in North American. We also outline the "Teaching Academy" concept, and the Engineering Faculty Academy for Scholarship in Teaching as it is evolving at Tennessee Technological University. It is hoped that the material presented here will be useful for readers who wish to develop similar programs at their own institutions.

FACULTY MENTORING IN THE UNITED STATES SINCE WORLD WAR II

For the purpose of this discussion, we divide the post WWII period into five distinct faculty mentoring eras in the United States. These are summarized in Table I. The time frames shown in Table I are approximations. The authors acknowledge that there are numerous institutional exceptions to the general outline presented here. The opinions expressed were developed based on personal experiences, observations, and conversations with faculty at literally dozens of Engineering programs in the United States over a period of three decades.

TABLE I
ENGINEERING FACULTY MENTORING IN THE UNITED STATES FROM WW II TO THE PRESENT

Era	Time Frame	Distinguishing Characteristics
Pre-Sputnik preparation for professional practice	1946 – 1957	Emphasis on teaching competence and collegiality. Mentoring random, if at all. Mentoring "by example."
Post-Sputnik transition to research	1958 - 1970	Emphasis on development of research capable faculty. Development of Ph.D. programs. Mentoring still random, and by example, if present at all.
Tenure tightening	1971 - 1980	Emphasis on research productivity. Elements of formal mentoring initiated. Major element of mentoring is informing untenured faculty of increased expectations.
Tight tenure with release and support	1981 - 1990	Emphasis continues on research productivity, but now with release from some teaching activities, and support in the form of "start up" grants, graduate student stipends, and similar helpful perquisites.
Release, support, and balance	1991 - present	Emphasis shifts to acknowledge importance of both teaching and research. Evolution of Teaching Academy concept. Formalized mentoring activities to improve quality of life and collegiality.

Pre-Sputnik Preparation for Professional Practice 1946 - 1957

In the years immediately following World War II, achievement of tenure was minimally difficult. Universities were more concerned about finding enough competent faculty members to teach the huge influx of students returning from military service than they were about holding each faculty member to the sort of Herculean standards that evolved later. Many, if not most, faculty in Engineering held M.S. degrees, rather than Ph.D. degrees, and it was very common to find faculty who had spent at least part of their career working as Engineers in industry. There was little emphasis on research or publication in most places. There were notable exceptions at the "great" universities (Ivy League, Big 10, and others), but even in these places, scholarship demonstrated through development of teaching materials (like text books) was held in just as high regard as scholarship demonstrated through development of research monographs or journal articles. There was greater emphasis on competence in the classroom and collegiality, than on scholarship. Tenure dossiers weren't prepared, faculty committees weren't called on to review performance, and most people who were considered for tenure during this period of expanding enrollments were successful.

Any mentoring that took place was "mentoring by example." In some cases, faculty achieved distinction by being so tough on their students that a significant number of students could not be classified as "successful learners." Faculty nicknames like "Flunking Freddy," or "The Red Vector" were monikers worn with pride. Such faculty members were often rewarded with tenure because they were dedicated to teaching, it was "macho" to be tough on the students, and there was a genuine need to have warm bodies available to cover the courses. Also in the post World War II era in the United States, it was hard to separate the worthwhile pedagogical aspects of a challenging curriculum from the less defendable lack of concern for demonstrated learning. If a student didn't learn, it was assumed that it was entirely the student's fault. If some students could succeed, that was proof enough that students who did not succeed had not applied themselves well enough. There was only minimal apparent awareness or acknowledgement of the idea that different students have different learning styles. Most faculty members developed the teaching style that had been most effective for their own learning, and students who didn't match this style well were out of luck.

In the three decades immediately following WWII (the decades dominated by faculty who were in place during and immediately after WWII), nearly every student who entered an Engineering degree program in the United States was told at the outset to "Look to your left and to your right. Only one of you will still be here at graduation." Achievement of tenure during this period was not traumatic at all. There were minimal expectations, and often faculty members

would learn of their award of tenure at the same time they learned that they were being considered for tenure at an annual evaluation. Decisions were made by a relatively small group of people, most often administrators in the direct management line affecting the faculty member (Chair, Dean, Provost, President).

Post-Sputnik Transition to Research 1958-1970

The seeds for change were sown with Sputnik in October of 1957. The success of Sputnik made it impossible to ignore the technical prowess of the Soviet Union, and particularly its ability to develop potential delivery systems for nuclear warheads. Faculty members were recognized as a potentially untapped resource whose technical expertise could be brought to bear on the serious research and development issues that faced the United States. Faculty members typically had several months that could be devoted to research activities each calendar year (three months in Summer, as well as one day each week that was typically allowed for consulting activities during the Academic Year). Successful use of faculty members on WWII era R&D projects like the Manhattan Project, general projects in electronics (sonar and radar for example), and operations research (Simplex Method and logistics for example) gave evidence to support the idea that faculty could make a strong contribution. It was recognized that the United States needed a stronger R&D capability, and that a step toward achieving this goal was to increase the research activities of faculty members in Science and Engineering.

This new focus on development of research capabilities lead to major changes in Engineering curricula in the United States. Pre Sputnik curricula in Engineering focused on professional practice. There had been a strong emphasis on methodology, rather than theory. There were significant "hands on" activities. This all changed after Sputnik. Curricula shifted to include significant elements that would prepare students for possible careers in research. Thorough knowledge of fundamental principles was recognized as an essential element for sound curricula. More complete preparation in mathematics, chemistry, and physics were incorporated into curricula. As the emphasis shifted away from Engineering practice and toward theoretical understanding, a schism developed in United States Engineering Education. The discipline of Engineering Technology was formed by faculty who wanted to maintain the focus on Professional Practice. Significant segments of United States industry needed graduates prepared with the emphasis on practical elements, and this provided a ready market for Engineering Technology programs. In the early days, graduates of Engineering Technology programs who could pass the P.E. examination were able to register as Professional Engineers right alongside graduates from Engineering programs, although in some States additional experience was required before Engineering Technology graduates could sit for the examination.

Meanwhile, Engineering faculty members needed assistants in their research, and relatively inexpensive assistants could come from the ranks of graduate students. Stipends and tuition waivers for graduate students in Engineering became the norm, with most of the funding coming from the United States Government. As more and more Ph.D. students completed their degrees, the Ph.D. became a necessary credential for a career in university level teaching.

During the decade that followed Sputnik, Engineering programs at Universities in the United States were ramping up their research capabilities. Tenure dossiers were still largely unknown. Committee reviews were still unusual rather than routine. There was a great emphasis on retraining older faculty for the new push for research, and Government and Foundation Grants were established to fund the return of M.S. holding faculty members to graduate school so that they could obtain doctoral degrees. There was little emphasis on mentoring, and what mentoring was done was again, "mentoring by example." Collegiality, competence in the classroom, and whether or not the candidate held a doctoral degree were the most significant factors in determining whether or not tenure would be granted in many institutions.

Tenure Tightening 1971 - 1980

The effect of all this was to lead to a large, mostly tenured faculty by the late 1960's. Universities began to realize that they could not afford to tenure everyone, and the accomplishments required to achieve tenure increased. Some universities put policies in place that pitted untenured faculty against each other. If one tenure-track slot was available, two or three assistant professors might be hired with the expectation that they would compete for the positive tenure decision at the end of the probationary period. The process could be fairly characterized as "cut throat" in many institutions. The first author on this paper recalls being told as a new assistant professor twenty three years ago that in order to achieve tenure, it would be necessary to publish fifteen refereed journal articles, obtain continued sponsorship for research from the National Science Foundation or some other Government Agency at the level of at least $50,000 per year, graduate at least one Ph.D. student before the end of the probationary period, and demonstrate suitable collegiality in support of departmental life, all within the first five years after completion of the Ph.D. degree. It is a miracle that any of us stayed in the profession with this sort of "mentoring." While it was common for the official channels to deny that there were formulae that that could be applied to achieve tenure, every untenured faculty member knew what defacto formulae were in place at their own institution, and how these formulae were evolving. This period, and the onset of the formulae phenomenon, marked the initiation of mentoring activities for untenured faculty.

Some senior faculty members started to realize that the expectations for accomplishments in research had grown to a very high level, and that many good people might not achieve tenure if they weren't at least made aware of the changing expectations. It was particularly ironic that the new tenure rules were largely defined by people who had achieved tenure more or less by earning their Ph.D. and reliably showing up for work each day. Thankfully, some of these people felt an obligation to assist their untenured colleagues through the maze they'd invented. First efforts at mentoring were informal, and largely anecdotal. Unsuccessful and successful tenure cases were discussed with untenured faculty members, usually with the admonition that "tenure is a moving target." We created a situation for untenured faculty members where 60 to 80 hour work weeks were necessary in order to meet expectations. This took a heavy toll on many families, and often lead to resentment and anger on the part of the faculty member that were only significantly manifested after the award of tenure. Tenure became a high jump, and once the jump was accomplished, the faculty member could rest on laurels and enjoy the freedom that tenure brought. To counter this "high jump" mentality, there has been a push at many institutions for post tenure review of senior faculty members, with mixed results.

Tight Tenure with Release and Support 1981 - 1990

From the initial attempts at mentoring by "informing," we progressed to mentoring by "release and support." During the 80's and 90's, and continuing to this day, untenured faculty have been informed of the expectations, but have also been given release from teaching activities, and other support in the form of funds to secure equipment, the promise of summer support, support for graduate students, and the like. Even Government agencies have adopted these ideas, by offering programs like the National Science Foundation Presidential Young Investigator Awards (which eventually evolved to become the current NSF Career Award). Mentoring by release and support has helped many untenured faculty members develop the research aspect of their career very effectively. Although these programs effectively helped faculty to become strong researchers, they did little to help faculty become excellent teachers. The important missing element in faculty development was "balance."

Release, Support, and Balance 1991 - Present

The great shift from teaching to research began with Sputnik, and had reached its farthest swing by the early 1990's. In the early 1990's, undergraduate teaching was again recognized as an important part of the university mission. In some parts of the United States the reborn interest in teaching and learning was driven by public outcries that student learning had become secondary so that faculty could pursue research. State Legislatures even got into the picture in some states, but in most institutions it was senior faculty members and administrators that recognized the fact that the quality of life for untenured faculty was often miserable, and that there were opportunities for improvements in teaching and learning in nearly every Engineering program. In recent years the development of ABET's EC 2000 guidelines has further focused attention on the quality of teaching, and the importance of measurement of student learning outcomes.

FORMAL MENTORING AND THE TEACHING ACADEMY CONCEPT

Several institutions can be identified as leaders in the movement toward formal untenured faculty mentoring. Hyperlinks to several such programs are given next.

The University of South Florida
http://www.cas.usf.edu/ADMIN_DEPTS/FACULTY_DEVELOPMENT
The University of Oregon
http://darkwing.uoregon.edu/~lbiggs/menpro.html
The University of British Columbia
http://www.cstudies.ubc.ca/facdev/services/faculty/mentoring.html
Stanford University
http://www-med.stanford.edu/school/facultymentoring/guidelines.html
Virginia Commonwealth University
http://www.vcu.edu/mdcweb/mentors/m-mentor.htm
Abilene Christian University
http://www.acu.edu/cte/facint/teaching/mentor.html
University of Wisconsin Oshkosh
http://www.uwosh.edu/mentoring/faculty/
The University of Illinois at Urbana-Champaign
http://ae3.cen.uiuc.edu/NTC/main.htm

The program at the University of Illinois stands out for those interested in Engineering Education because it was initiated in their College of Engineering, and has since spawned similar programs in several of their other Colleges. The Teaching Academy concept appears to have grown out of an Engineering Dean's Retreat in 1994. It is currently manifested in their Academy for Excellence in Engineering Education (AE^3). Their primary goal, simply stated, is "to help new faculty members be successful in all aspects of their careers, including executing efficient and effective instruction" [1]. The Teaching Academy approach at Illinois has been built around the idea that, if senior faculty (mentors) view teaching as important, untenured faculty will strive to become excellent teachers. An important part of the program at Illinois is that faculty work together to help each other improve. The graduates of the program one year become mentors for participants in the program the next. Activities include workshops, weekly meetings class projects, teaching seminars, teacher class visits, personal development projects, and paired observer assessments with video taping. The single activity with the greatest benefit for

the least cost was identified by the participants as peer evaluation. This will be discussed at greater length later.

During presentations at the University of Illinois in March 2001, it was fascinating to hear testimonials from Assistant and Associate Professors who had gone through the program. They made a convincing case for the idea that they had benefited significantly, both professionally and personally. In fact, several participants remarked that once the program was over, they missed the regular meetings with colleagues from other disciplines. Several strong friendships had grown out of the program. It was especially exciting to hear these young faculty members who had been recruited into one of the best research environments in the world make comments about how the Teaching Academy concept had helped them become more efficient and effective teachers, and that this had improved the overall quality of their lives. Some expressed the view that their students were learning more, and that they had more time for their research. The Teaching Academy at the University of Illinois certainly had all the characteristics of a win-win activity.

From our perspective at Tennessee Tech, the most valuable feature of the University of Illinois program is that they are willing and, through the generosity of the General Electric Foundation, able to share their success with other institutions through their project called "The National Teaching College." The National Teaching College is a three phase project that now involves eighteen universities lead by the University of Illinois. At this stage, the participants are Tennessee Technological University, Ohio State University, University of Texas at Austin, University of New Orleans, Boston University, Wright State University, Fairfield University, Oklahoma Christian University, University of Missouri – Columbia, Arizona State University, Texas A&M University – Kingsville, University of Washington, Louisiana Tech University, Kettering University, South Dakota School of Mines and Technology, Brigham Young University, and Indiana University Purdue University Indianapolis. The participants are currently working to finalize the plans they developed as part of Phase I, and to secure funding for implementation. Phase II takes place in early August 2001. Each participant will outline their progress toward implementation of their Phase I plan at that time. In Phase III, site visits will be conducted to review, evaluate, and assess the implementations.

THE ENGINEERING FACULTY ACADEMY FOR SCHOLARSHIP IN TEACHING AT TENNESSEE TECHNOLOGICAL UNIVERSITY

The Teaching Academy as it is evolving at Tennessee Technological University will enroll its first faculty members in the Fall of 2001. We have tentatively developed the acronym E-FAST as the short name for the Academy, but this isn't cast in stone. The idea has been expressed that, while "e-anything" is a catchy name in 2001, as the e-craze passes, the name will be dated. Nevertheless, whether this acronym sticks or not, there is consensus that we like the idea of an Engineering Faculty Academy for Scholarship in Teaching. We want to include the word *Engineering*, because this distinguishes the activity for Engineering faculty members and should improve participation due to increased sense of ownership. We want to include the word *Faculty*, again because this is a faculty activity, with faculty defined programs, and peer faculty interactions. We want to include the word *Scholarship*, because we believe that teaching and learning are scholarly activities, and that this distinguishes what we do in the College of Engineering from "training." We want to encourage our faculty to prove their excellence as teachers by sharing their knowledge of teaching through the body of pedagogical literature in Engineering Education.

Organization and Funding

The current organization of our Academy is defined by a steering committee. Members of the steering committee come from each of the teaching departments. In addition to developing an initial three year plan for the Academy, the members of the steering committee will also assist as mentors and peer evaluators during the first year of the program. In subsequent years, we intend to follow the Illinois model and use graduates of the program as mentors for the next group of participants. Funding for the first year's activities will come from salary savings generated by research release time from members of the College of Engineering Dean's Office and others, from research overhead return that comes to the College, and from endowment income that can be used to support faculty development activities. The whole concept of a Teaching Academy has potential for external fund-raising. The Academy is an entity that could attract donations for an endowment, and it would also appear to be appropriate as a platform to be supported by external grants and contracts (as Illinois appears to have successfully done with the General Electric Foundation, for example).

Among the participants in the first year will be new faculty who are being drafted into the program as a "perq" associated with their start up package. With enthusiastic support from the Chairs and the Dean, we anticipate that these participants will be among the most committed. We are also encouraging senior faculty to "self-select" into the program. We anticipate that if tenured faculty show that they take scholarship in teaching seriously, this will be a good example for untenured faculty, and the end result will be better student learning outcomes.

First Year Activities

The program will begin in August 2001. Over the course of the academic year we will include 15 formal activities, approximately one every other week. Most activities will

include a social component with refreshments served either before or after the main activity to build spirit and camaraderie. We will have six programs developed by Education Psychology faculty from our College of Education. Most Engineering faculty have never had any formal instruction in the theory of teaching or learning. These programs will be geared toward problem and project based curricula. We will also have six programs developed by senior College of Engineering faculty who have proven year after year to be masters in achieving excellent student outcomes. These programs are necessary to demonstrate our recognition of the accomplishments of those that have already proven to be our best and brightest teachers. Finally, we will have three "workshop" level programs from outside suppliers, like Felder and Brent as outlined on their web site http://www2.ncsu.edu/unity/lockers/users/f/felder/public/Workshops.html The external programs will provide us with national / international perspective, and the expenditure will demonstrate our serious commitment to continued improvement of teaching and learning. One of the externally supplied programs will tie our curricula, teaching, learning, and assessment to ABET's EC 2000 guidelines, to facilitate faculty ownership, buy-in, and participation in anticipation of our accreditation visit during Fall 2002. We anticipate in years two and three that we will be able to share home grown programs with other universities that are participating in the University of Illinois' National Teaching College. This should add diversity and control costs in the second and third years.

In the second semester of each year, we will incorporate a peer review activity. At the National Teaching College workshop at the University of Illinois in March 2001, Bruce Litchfield observed that peer review was the single most effective activity that they had introduced in their AE^3 program. However, during the workshop the Illinois team also pointed out that in order to be effective as a mentoring tool, peer review has to be carefully defined and implemented. If not done properly, peer review can be threatening, and a negative activity rather than a positive one.

Peer Review Guidelines

First and foremost, peer review will be confidential. The only person who will be entitled to the information generated by the review will be the faculty member who is under evaluation. Experience at other institutions indicates that, when peer review is positive, evaluated faculty members tend to want to share the results with their tenure review committee. This will be encouraged, but it would bring risk to the process if the evaluations weren't confidential, and we do not wish to add this element of risk (and its attendant faculty discomfort) to E-FAST. We want the whole activity to be as positive as possible.

The peer evaluations will be conducted by teams of two faculty members who are both respected for their own effectiveness as teaching scholars. The team members will NOT come from the discipline of the faculty member who is to be evaluated. If the team members were from the discipline of the person under evaluation, it would be too difficult to assure confidentiality during subsequent tenure evaluation, and evaluated faculty might feel intimidated. The purpose of the peer review is NOT to discover who does well in the classroom and who does not. The purpose of the peer review is to help everyone improve their outcomes in the classroom, no matter what their current level of performance. It is anticipated that one member of the peer review team will come from the College of Education, and one will come from one a different department in the College of Engineering.

Peer review will include a meeting with the faculty member prior to the classroom evaluation, it will include a classroom visit (complete with video taping), it will include a meeting with students in the class, and it will include debriefing with the evaluated faculty member. Prior to the debriefing, the team will meet to prepare a formal evaluation. Both members of the team must be in complete agreement on all elements of the evaluation before the debriefing will be scheduled.

CONCLUSION

We have been fortunate at Tennessee Technological University to attract and retain a high quality faculty, characterized by their dedication to excellence in both teaching and research. As we move into a new era of new faculty recruiting, the Teaching Academy concept allows us to talk with prospective faculty members about career balance, and this is an attractive concept for many prospects. Further, E-FAST provides a vehicle to facilitate the development of the curricular changes that are necessary to meet ABET's EC 2000 guidelines. E-FAST is being implemented this semester, and we look forward to presenting a discussion of the results at a future conference.

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REFERENCE

[1] Litchfield, Bruce, "Getting Your Engineering Faculty Off to the Best Start," presented at The National Teaching College, University of Illinois at Urbana – Champaign, March 15, 2001.