ABET's Technological Education Initiative: Focus on Faculty

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Abstract

The Accreditation Board for Engineering and Technology, with support from the National Science Foundation's Advanced Technological Education program, is conducting twelve hands-on regional faculty workshops for engineering technology educators. The purpose of the Technological Education Initiative (TEI) workshops is to enhance faculty's knowledge of emerging technologies, explore ways in which these technologies may be incorporated into their programs, and provide faculty with experience in developing effective assessment strategies that measure the impact of curricular innovation on the performance of their graduates. Partnering with four of NSF's ATE Centers of Excellence, the Global Wireless Education Consortium, and industries across the country, ABET is introducing faculty to tools which will help them to develop innovative, relevant, and attractive academic programs. This paper will provide an introduction and background of this initiative, will describe the actual workshops, and will reflect on continuous improvement as it relates to ongoing workshops.

Framing the Challenge

Rapid advances in technology demand that students receive an education that will provide them career opportunities with greater mobility and transitional capabilities. Training that meets immediate industry need but offers limited career opportunity is unacceptable. Technology graduates often find themselves restricted by skills with a short "half life." In other words, they are unable to move forward in their careers or their education and forced to start the learning process over again.

Since 1992, when Congress enacted the Scientific and Advanced Technology Act (SATA), technician education has been given increased attention. SATA called for the establishment of "a national advanced technician program, utilizing the resources of the Nation's two-year associate-degree-granting colleges, to expand the pool of skilled technicians in strategic advanced technology fields to increase the productivity of the Nation's industries, and to improve the competitiveness of the United States in international trade." [1] In response to this Congressional mandate, the National Science Foundation's Advanced Technological Education (ATE) program was created. Since 1993, the ATE program has funded projects and centers that focus on the improvement of technician education and, thus, on producing a technologically prepared workforce.[2]

Shortly after SATA was passed, NSF convened a workshop to address critical issues in science and engineering technician education. The recommendations from this workshop were published in 1993 in *Gaining the Competitive Edge*.[3] Among the recommendations of this report was a call to stakeholders--administrators and faculty, employers, professional societies, and government--to "catalyze educational reform that gives a high priority to faculty enhancement and preparation," and to "address essential standards for the development of technical curricula and assure quality programs through accreditation of programs and other similar means." The report also called for the establishment of alliances to "provide regular opportunities for faculty and teachers to update content knowledge and pedagogical skills and remain current with technological developments."

Manufacturing is one of the many industrial sectors that has explicitly recognized the need to devote greater attention to technological education. In 1997, the Society of Manufacturing Engineers (SME) and the SME Education Foundation published “competency gaps” that were used as a basis for consideration of proposals submitted to the Foundation's ongoing Manufacturing Education Plan (MEP) grants program.[4] In 1999, SME surveyed manufacturing industry respondents. In this survey they were asked to review the 1997 competency gaps in relation to recently hired college or university graduates of manufacturing engineering or technology programs, rating how well these new graduates met expectations. Through this approach, workplace competencies were ranked, with the most critical professional gaps identified as follows:

- Business knowledge/skills
- Project management
- Written communication
- Oral communication/listening
- International perspective

A simple, yet radical, change in focus from inputs (i.e., curriculum content) to outcomes (i.e., knowledge and skills of technologists and technicians) is providing a powerful lever in motivating academic institutions to rethink and overhaul traditional teaching methods and curricula. Additionally, this change in focus offers programs the opportunity to establish accountability measures being demanded by students, parents, trustees, politicians, and society at large.

The Accreditation Board for Engineering Technology (ABET) has long played a significant role in the quality assurance of engineering and technology education. Since 1946, ABET has accredited engineering technology programs at both two- and four-year institutions. Over the past few years, ABET gained significant experience through implementation of outcomes-based criteria, Engineering Criteria 2000 (EC2000).[5] As EC2000 evolved, it became clear that the key to a successful paradigm shift in engineering education rested with the faculty as providers of the educational experience. With that in mind, ABET developed and delivered, with support from NSF and industry, a series of highly successful regional faculty workshops for EC2000. These workshops were designed to assist faculty in understanding the basics of continuous program improvement and to apply this process on their own campuses. Based on follow-up

communication with participating faculty, we know that they are utilizing their workshop experiences to develop program-specific assessment plans that help determine the success of curricular reform and program innovations.

The Technology Accreditation Commission (TAC) of ABET has recently introduced Technology Criteria 2000 (TC2K).[6] Like EC2000, these new evaluation criteria are outcomes based and constitute a significant shift in emphasis from what students are taught to what students learn. In the fall of 2001, ABET conducted its first pilot studies under the new technology criteria. The pilot studies consisted of a series of on-site visits with volunteer institutions chosen to provide a sampling of the wide diversity of technological education programs. From these pilot studies, the Technology Accreditation Commission of ABET is gaining a greater understanding of faculty's critical link to the success and understanding of outcomes assessment in the development of innovative, quality programs.

Building the Team and Designing the Project

With the EC2000 engineering workshops as a foundation, coupled with the initial experiences of TC2K and government's call for increased attention to preparation of the nation's technical workforce, ABET has embarked on a project to foster continuous quality improvement of technology programs throughout the country. With significant funding from the National Science Foundation's Advanced Technological Education (ATE) program, ABET is implementing the Technological Education Initiative (TEI) workshops. The TEI goals are to enhance faculty's knowledge of emerging technologies, explore ways in which these technologies may be incorporated in academic programs, and provide faculty with experience in developing effective assessment strategies that measure the impact of curricular innovation on the performance of their graduates.

The TEI workshops are significantly enhanced through partnerships with the South Carolina ATE Center of Excellence, the Northeast Center for Telecommunications Technologies (NCTT), the Advanced Integrated Manufacturing Center (AIM), the New Jersey Center for Advanced Technological Education (NJCATE), and the Global Wireless Education Consortium (GWEC). These partners are well established and all have received significant funding from NSF's ATE program. Each partner brings a unique perspective to the project, and all have a wealth of experience in designing programs and curricula for technician education.

The South Carolina ATE Center of Excellence is dedicated to "increasing the quality, quantity and diversity of engineering technology graduates to support economic development in South Carolina."[7] The Center has developed an integrated, problem-based curriculum and has fostered multidisciplinary faculty teams working collaboratively to optimize teaching and learning in the classroom. NCTT, based at Springfield Technical Community College in Massachusetts, is an ATE Center for Excellence in the instruction of Telecommunications Engineering Technology. The mission of the NCTT is to "promote quality technological instruction and to ensure the globally competitive advantage of America's telecommunications industries." [8] The AIM Center, based at Sinclair Community College in Dayton, Ohio, is focused on developing a "customer-driven approach to manufacturing education." The program's primary goals are to develop interdisciplinary curriculum materials leading to an associate's degree in manufacturing

engineering technology, and to provide substantial faculty development opportunities for all educators involved in manufacturing-related fields, including mathematics, science, communications, business, and engineering technology.[9] NJCATE is "creating a model for the development of technician education programs" through creation of their unique Mecomtronics (an innovative program designed to meet industry needs for multifunctional technicians in MEchanics, COMputer, teleCOMmunications and elecTRONICS technology) Engineering Technology and the Telemedia Communications Technology Associate in Applied Sciences degree programs. This curriculum model combines technical and core subject matter in modular courses using activity-based, project-centered, and just-in-time methods of educational delivery.[10] GWEC's mission is to "increase the quality and quantity of technicians, engineers and information technology specialists for the wireless industry." At GWEC, wireless companies and academic institutions are "working together to design and develop current, relevant wireless courses."[11]

All of these partners have made a significant positive contribution to development of the TEI project. In addition, center and consortium directors are serving on the TEI project planning team, participating in the workshops, providing assistance with organizing, executing, and marketing a workshop in their center's region, and disseminating project information and outcomes via their websites and listservs. The partners have also helped ABET to obtain industrial support for the workshops and linkages with the American Association of Community Colleges and the League for Innovation.

Additional key collaborators in TEI are the business and industry partners. Each of these partners provides site accommodations, meals, and an in-depth look at the emerging technologies that are shaping their company and giving them a competitive edge. In addition to providing logistical support for the workshop and an in-depth tour of the facility, each industry host is asked to provide a senior executive to deliver a keynote address and two industry representatives with experience in quality improvement. The industry representatives are asked to participate in the entire workshop and to provide a summary of their observations at its conclusion. The idea is to get faculty into the work environment of these companies and to provide industry with an opportunity to interact with faculty from regional institutions. The keynote address is designed to inform faculty about the current state of the technical workforce and to provide a philosophical overview of quality assurance in the corporate culture. These presentations and visits provided a foundation for the faculty to begin examining continuous program improvement. To date, industry partners include Huffman Corporation, Microsoft, Caterpillar, Johnson and Johnson, Raytheon, Lucent Technologies, Rockwell, and Boeing.

TEI is being designed as a series of twelve workshops to be conducted in different regions around the United States over a three-year period. Workshop sites are chosen based on the potential to reach significant populations of engineering technology faculty and to partner with a dynamic high-tech company. Each institution is invited to send two faculty members to the workshop. Academic institutions include both two- and four-year colleges and universities, and faculty participants are from TAC of ABET as well as non-accredited programs.
Each two-day workshop accommodates 75 participants: 60 technology faculty, TAC ABET trained team chairs and program evaluators serving as facilitators, professional society observers, an assessment expert, and industry continuous improvement representatives.

When ABET conducted workshops for the engineering community, it essentially had a captive audience. All participants were from ABET accredited engineering programs and, since nearly all engineering programs are accredited by ABET, would eventually be involved with their programs' EC2000 accreditation visits. Already embedded in their thoughts was the issue of how to get ready for EC2000 as painlessly as possible. Some hoped that the workshops would give them guidance in how to "pass the EC2000 test." This is not the case with a significant population of TEI workshop participants.

Can we reach faculty who have no vested interest or burning desire to have their programs accredited? Can we provide a program such that they go back to their institutions and convince others --because continuous quality improvement is not implemented without the support of administration and buy in from other faculty--to get on the CQI bandwagon? We are working to insure that the answer to this question is a resounding *yes*.

The focus of continuous quality improvement is not on the curriculum, and we tell participants that up front in the workshops. We are asking them to look at the "big picture" and to forget about their courses for a few days. But we all know that engineering technology faculty naturally focus on their courses. Why? Because they care about their students. Because it's what they're good at and know best. But how often do faculty look at the big picture? When is their focus on the entire program, program objectives and outcomes, and assessment and evaluation of those objectives and outcomes? Are faculty in the business of looking at their students in a holistic way? Why should they care about this big picture? Why should they care about assessment?

Robert Holyer, in "The Road Not Taken," states[12]

> It is now 10 full years since the accrediting agencies began requiring assessment, and many of the faculty I know are still not excited about it….
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> Up to a point, their lack of enthusiasm is easy to understand. Like most people these days, faculty members are already over-scheduled, and assessment is simply one more thing to do. Worse still, it is the kind of work that we are not particularly good or practiced at. The culture of American higher education encourages a high degree of individual autonomy: we design our own courses, do our own teaching, set our own standards, and construct and grade our own exams. And we try to do all of these things with an efficiency that still leaves us time for 'our own work.'
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> Assessment, on the other hand, requires us to work together, and to do unfamiliar things like setting common goals and standards, devising methods of assessment, interpreting the results, and using them to improve and coordinate our teaching. Assessment, then, possesses all the appeal and efficiency of committee work, in particular the kind visited upon us by administrators.

What motivates faculty is the desire to optimize their students' learning and help them to succeed. What if faculty could be convinced (or better yet, if they would come to the realization themselves!) that outcomes assessment is a good thing and will ultimately help their students succeed? They just might buy in to looking at the big picture. Andrew Sorensen, president of the University of Alabama, points out, “We find that our faculty consistently support those improvements that clearly benefit the students and the learning process.”[13] Through continuous

quality improvement, we believe that faculty can embrace a process that will, in fact, provide significant benefits to student learning.

The Workshop as Conceived and Delivered

The goals of the TEI workshops are four-fold: to develop an awareness of learning-outcomes based program development; to develop an awareness of the meaning and linkages among program educational objectives, program outcomes, assessment, evaluation, and constituencies; to develop an awareness of a variety of assessment tools and their respective features, assets, utility, relevance and limitations; and to illustrate the structured and cyclic nature of planning, implementation, assessment, evaluation, feedback and change in a continuous quality improvement environment.

The TEI workshop structure includes three distinct but interrelated components: "Emerging Technologies Day" to give participants a glimpse of what industry is doing and how their graduates might function in a high tech, global environment; small group (5-7 participants per group) discussions of case studies to help participants learn how to develop effective and appropriate program objectives and educational outcomes; and a jigsaw exercise providing an overview of assessment tools that can be utilized to develop an outcomes assessment plan. Plenary sessions are also held to give participants a foundation in assessment and CQI, and to provide an opportunity for sharing of lessons learned.

The workshops are designed to build upon the course-level assessment knowledge faculty members already possess by getting them to use it as a foundation for expanding their understanding of assessment to the program level. This approach to learning known as constructivism purports that learning is an active endeavor rather than a passive one. Teachers encourage group interaction, where the interplay among participants helps individuals become explicit about their own understanding by comparing it to that of their peers. The teacher (workshop leader and facilitators) no longer acts as the “talking head” expert, but assumes the role of mentor, guiding the students (participants). This perhaps is described best in the key tenets of constructivism as developed by Martin Dougiamas (A Journey Into Constructivism, 1998)[14]:

- Faculty members come to the workshop with an established world-view, formed by years of prior experience and learning.
- Even as it evolves, a faculty member’s world-view filters all experiences and affects their interpretation of observations.
- For faculty members to change their world-view requires work.
- Faculty members learn from each other as well as from the workshop leader and facilitators.
- Faculty members learn better by doing.
- Allowing and creating opportunities for all to have a voice promotes the construction of new ideas.

The following is a brief overview of the inaugural workshop to provide a glimpse into the workshops themselves. A total of 58 participants attended this workshop. Among these were 7 African-Americans and 10 women.

The first Technological Education Initiative Faculty Workshop was held September 7,8 and 9, 2001 in Rock Hill, South Carolina. The South Carolina Advanced Technological Education Center (SC ATE) under the leadership of Elaine Craft helped ABET to find the optimum site for the workshop and was instrumental in having Huffman Corporation, our industrial partner, commit to the workshop.

Specific activities of the workshop in Rock Hill included:

Friday, September 7, 2001.

- *A visit to Huffman Corporation, located in Clover, South Carolina. Huffman manufactures CNC multi-axis grinders, lasers, and waterjet machining systems. This is a relatively small but globally connected, impressive company that focuses on rigorous attention to customers and high quality products. President Roger Hayes provided workshop participants with an overview of the company and focused on the theme of continuous quality improvement. This was followed by a tour of the Huffman facilities, where participants were introduced to seven areas: the subassembly, main assembly, coordinate measuring machine area, Springfield Manufacturing (an affiliated waterjet cutting production facility), aftermarket services, mechanical/electrical department, and virtual simulation activities.*

Saturday, September 8.

- *An overview that outlined the goals of the workshop and provided a summary of CQI.*
- *An introductory exercise for participants to ponder and discuss program educational objectives and outcomes. The exercise centered on a fictitious case study of a community college. Program objectives and outcomes were critiqued, and then participants were asked to generate a list of attributes of effective program objectives and outcomes. This activity was conducted in small group settings, with each workshop facilitator overseeing two of the ten groups. A few of the groups then reported their findings to the entire group in a plenary session.*
- *An overview of assessment tools.*
- *A follow-up "jigsaw exercise" in which participants became "experts" on a particular assessment tool, then reported back to their small groups about that tool. This was coupled with another exercise in which they had to choose a variety of appropriate assessment tools for fictitious case studies.*
- *An exercise focusing on assessment and evaluation plans for both objectives and outcomes.*

Sunday, September 9.

- *Exercises to develop program objectives, outcomes and assessment/evaluation plans for "Regional State College" fictitious case study.*

- *Final report-out session, including "Points of Learning." Participants were asked to reflect on the key things they learned from the workshop.*
- *Summary reports from Huffman participants Thad Baird, Vice President of Operations and Chet Janes, Manager of Quality Assurance*

Continuous Improvement in Our Backyard: Practicing What We Preach

So we continue to ask the questions: What are the lessons learned? What do we need to do to improve TEI? What does *our* continuous improvement model look like? We want to have a successful workshop—but we must be able to measure that success, not simply generate a feel-good attitude among workshop participants. How do we foster the summative and long-term success of the workshop? This is the critical issue that we continue to grapple with.

As is customary with faculty development activities, an evaluation is conducted at the end of each TEI workshop. Results in general have been encouraging. Respondents rated the components of the workshop on a scale of 1 - 5 with 5 being the most favorable. For the first workshop in Rock Hill, South Carolina, Emerging Technologies Day at Huffman Corporation was an unequivocal success. The level and quality of information that Huffman provided, as well as potential impact to the faculty's curriculum and relevance to their professional interests, were all highly rated by participants. The CQI and assessment segments were also favorably received. For example, respondents agreed that the workshop exercises were helpful for developing a continuous improvement plan for their programs. In addition, a large majority of participants said they would recommend the workshop to another faculty member.

Still, participants were clear that there is room for improvement. Evaluations from the first workshop indicated a need to better inform the participants up front (prior to the workshop and during the initial overview) about the workshop objectives. They felt that Emerging Technologies Day should be more strongly tied into subsequent workshop activities. They also recommended that the exercises (specific case studies) be modified to better reflect the participants' institutions. We have taken steps to remedy these issues for subsequent workshops.

Another recurring theme from participant surveys was that workshop activities should provide more guidance especially in the way of examples. One comment, for example, indicated "some do not know enough about the [CQI] process to evaluate examples well." It is a struggle to strike a balance between providing "the right answers" (in the case of developing program objectives and outcomes, there can be many appropriate answers!) and allowing participants to construct their own knowledge. We favor the constructivist approach, but we need to do better in the way of guiding them and asking the right questions. Our efforts here are a work in progress.

Exit surveys from the second workshop, held at Microsoft Corporation in Redmond, Washington, indicated that participants were still not satisfied with the level of background information provided prior to the workshop, but they were more positive concerning facilitator guidance and instruction. Many respondents commented on the positive nature of working in small groups. On the other hand, participants are still not happy with the materials and case studies, finding some of the descriptions and directions to be confusing. It is apparent that more work needs to be done to increase the clarity of the written materials and accompanying

instructions. Discussions about these issues have already taken place, and we will continue to work toward optimization of the workshop's content and process.

Plans are under way to do a follow-up assessment and evaluation of each of the workshops. These plans include contacting a random sampling of participants, and also asking all participants to complete a Web-based survey that will get at the "what have you done as a result of attending TEI?" question. We know that follow-up with participants is critical. We want to empower participants to be catalysts and change agents at their institutions. We want to guide participants in follow-up activities that help them implement what they have learned. This also is a work in progress.

The ATE Centers and GWEC have been critical to the successful development of TEI. These organizations are gold mines of knowledge in program improvement and curricular reform of technician education. We need to do a better job of providing workshop participants with a taste of their exemplary activities and a way to connect with the leadership in these organizations. We will continue to seek ways to make this happen.

One question well worth asking, no doubt asked countless times by workshop facilitators, is "What constitutes a successful workshop"? Here are some ideas that we believe to be among the characteristics of exemplary professional experiences:

- Give them something of quality they want and/or need
- Make them work hard
- Make it fun and exciting, with ample time for participants to "connect"
- Establish a community of practitioners
- Make connections to their existing knowledge (find out what their existing knowledge *is*!)
- Make them think about the future—and want to do something about it after they leave
- Provide follow-up and guidance beyond the workshop

This list, along with participant feedback, will continue to guide us as we work to improve TEI.

We believe that we are making progress, for we know, as a recent Chinese fortune cookie so elegantly pointed out, that "discontent is the first step in the progress of a man or a nation" (Some digging reveals that this is in fact a bit of Oscar Wilde wisdom!)--and we continue to experience relentless discomfort! But we are also asking faculty to leave their comfort zones. We are asking them to think about changing the way they go about their business. And we know that successful change requires energy and time. And real and sustainable change occurs incrementally over time.[15]

As our educational systems move away from input and process, and toward assessment of outcomes, it is imperative that we have faculty who become champions of the idea that it is far more important to measure what their students know and are able to do than to simply look at the content and coverage of their courses. The idea of continuous quality improvement, while not foreign to most engineering and technology faculty, is not widely practiced in our educational

institutions. This must change if we are to maintain a competitive edge in this country. With TEI, we are working toward facilitating that change in the engineering technology community.

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