Preparing for Participation in SPEED: An ASEE Initiative for a Nationally Recognized Development Program for Engineering Educators

Abstract

Engineering and engineering technology departments have a long history of adapting to changing societal needs so that their graduates will possess relevant skills and knowledge vital to potential employers. In parallel with the changing engineering and engineering technology curriculum, there has also been a long-standing call to strengthen engineering and technology educators' capabilities and preparation to perform the task of educating students. This latter call, however, had remained virtually unanswered for more than a century. A recent response to this call is SPEED: *Strengthening the Performance of Engineering and Engineering Technology Educators across the Disciplines*. SPEED is a concept for a formal, nationally recognized continuing education program for engineering and technology educators being developed with the support of the ASEE. In the introductory part of this paper, the authors briefly present an overview of previous work which has led to the development of a vision for SPEED and its conceptual design. This overview includes comments on current professional development opportunities for faculty across the world, and the challenges, opportunities and critical elements that would be associated with a successful professional educational development program. We then offer a set of core competencies areas which would likely be required of faculty who finish such professional development. Finally, we conclude with some specifics about the proposed SPEED program. We offer some details on its current design and describe plans to engage relevant constituencies and create buy-in from the community.

Origins of SPEED and previous work

Engineering and engineering technology (EET) departments have a long history of adapting to changing societal needs so that their graduates will possess relevant skills and knowledge vital to potential employers. In parallel with the changing engineering and engineering technology curriculum, there has also been a long-standing call to strengthen engineering and technology educators' capabilities and preparation to perform the task of educating students. This latter call, however, had remained virtually unanswered for more than a century. A recent response to this call is SPEED: *Strengthening the Performance of Engineering and Engineering Technology Educators across the Disciplines*. SPEED is a concept for a formal, nationally recognized continuing education program for engineering and technology educators being developed with the support of the ASEE[1]. A brief overview of previous work which has led to the development of a vision for SPEED and its conceptual design is presented in the following section.

Professional faculty development and recognition across the world

Around the world, several programs to support professional qualification, development and/or recognition for those teaching in higher education are known[2]. They vary considerably in scope, administration and reputation. An analysis of existing models reveals the following programmatic elements to guide comparison[2]:

- *Who is the governing association or body for the professional development program*

- *Who is responsible for professional development program enforcement*?
- *How is the professional development program implemented at the national level*?
- *How is the professional development program implemented at the local level?*
- *How is the professional development program included in accreditation?*
- *Is participation compulsory or voluntarily?*
- *Who is/are the target group(s)?*
- *What is the professional development program duration?*
- *What is the professional development program content?*
- *How are qualifications recognized and/or rewarded*?

Clearly criteria, standards, and policy regarding professional qualification for teaching in higher education are unique to each nation's needs, interests, and cultural expectations. Initial training of university teachers has been established in almost every university in the United Kingdom, Norway and Sri Lanka. It is also becoming increasingly common in many other countries. From beginning as small in scale, low in credibility and poorly supported, substantial training of 120-500 hours duration is now well embedded in many institutions across multiple nations, is often compulsory and is sometimes linked to probation or tenure. Major programs include a coherent series of meetings and various learning activities spread over a period of 4-18 months, usually with elements of both formative and summative assessment. Many of these programs are so-called postgraduate certificate courses subject to formal academic approval and quality assurance, which in addition lead to nationwide professional registration.

Based on both statistical evidence as well as a substantial amount of informal and anecdotal evidence, the success of professional development programs in the educational sector has encouraged more and more countries across the world to begin to implement various types of programs. There is also a growing demand for professional certification and registration in the educational sector. Long-term, this might have a significant impact on faculty recruitment, promotion and tenure, salary development, and from an institutional perspective accreditation and fund raising. While these statements appear to hold true in general, there does not appear to be any single "best option" to be implemented within the US in the short term considering the current cultural and societal context. For a more detailed discussions of the above-mentioned models as well as an overview of education-related faculty development initiatives in the US please refer to Schaefer[2] and Utschig[3].

Challenges and opportunities in professional education-related faculty development

Important opportunities and challenges relating to formal education-related faculty development on a large scale are outlined in Utschig and Schaefer[4]. In this work, questions explored are: *What major opportunities exist regarding moving towards educational professional qualification for US Higher Education institutions, their faculty and students, industry, and society as a whole? How can resources be synergistically integrated to support such an effort? What are the major challenges or barriers present that must be overcome in order to create such a system?*
In response to these questions, they present a concept map to explore how faculty educational development could support and greatly enhance an entire system revolving around faculty development in teaching and learning. Utilizing and reflecting upon the literature, major issues considered that relate to the questions above include various roles in the higher education

engineering community; relationships between educational research, student learning outcomes, and engineering faculty; resources supporting engineering education, and the implication of different faculty reward structures. Analysis indicates that pieces already in place offer great potential to create the Engineering Education of 2020 for "The Engineer of 2020" if key barriers are addressed.

Fortunately, current conditions in the US display more opportunities than challenges. This indicates great potential for moving forward, as we are doing with the current SPEED initiative. Fostering and growing relationships among the various constituents in the engineering education community, along with delivering rewards that match the language in mission statements and professional expectations for promotion and tenure, are certainly possible under current conditions. However, the challenges still represent significant barriers. Resources, both in funding and human capital, will always be insufficient unless a clear shift in roles occurs such that professional development and faculty performance in engineering education philosophically become clear competitors with research. Currently, there is no infrastructure in place to support such a philosophical shift in how faculty, departmental, and institutional roles can leverage widespread implementation of faculty development as educators in engineering. Nonetheless, overcoming these barriers is essential. Without doing so it will be virtually impossible to offer an Engineering Education of 2020 that achieves the learning outcomes desired for The Engineer of 2020.

Critical elements of professional faculty development and recognition programs

Utschig and Schaefer[3] present three critical elements needed for any successful US program seeking to establish excellence in engineering education through professional education and recognition of faculty teaching in higher education. The ultimate goal of such faculty development programs is to help propel engineering education to a point where most faculty can be described as scholarly teachers. Building on concepts well grounded in literature[8], the critical elements identified were: (1) support by a nationally respected society or academy, (2) utilization of qualifying criteria or standards at several levels, and (3) flexibility in implementation across a variety of university administrative structures and cultures[3].

> Critical Element #1: A sponsoring society or academy needs to fulfill a number of requirements. Respect can be achieved through the quality and reputation of its members as well as through its influence across institutions. Next, the sponsor needs to be a stakeholder in the success of the program. It must also be able to commit resources to the program. Furthermore, it will need a highly visible personality as a champion and should be viewed independent of the institutions it serves. Finally, involvement in continuing research in engineering education is important.
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> Critical Element #2: It will be supported by qualifying criteria or standards at several levels of expertise with clear criteria at each level and will include both practicum and training components. Different levels of certification represent the continuous evolutionary journey one undergoes as an educator. We discuss these proposed tiers in a later section.
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> Critical Element #3***:*** It will accommodate flexibility in implementation across a variety of university administrative structures and cultures. Each college and university deserves the authority to implement such a system in ways that make sense within its own institutional culture and administrative structure. Excellent general resources on organizational change exist in the

literature. Because each institution can approach their system independently, the intent should not be to prescribe the methods, but rather the standards to which they must rise as measured through the outcomes they achieve. These outcomes can then be held up to statewide or national standards reflected in critical element #2 and enforced via the sponsoring society as discussed in critical element #1.

Identifying core competencies

Identifying the core competencies and associated performance criteria to be developed through participation in a SPEED program is a challenging task which requires input from multiple stakeholders. The basis for the initial set of competencies and performance criteria can be drawn from the literature on current faculty development practices both in the U.S. and internationally[2, 5-9].

Proposed competencies for U.S. faculty have been articulated as part of faculty development models at numerous individual universities such as the University of Michigan[5], Tufts[6], learning centers such as the Fleming Center for Teaching and Learning[7], and NSF-supported development efforts targeted primarily to graduate students such as CIRTL. In addition, there have been more extensive efforts to articulate and promote broad faculty teaching competencies at several European universities, especially in the U.K.[8] through initiatives such as the IGIP model[9]. While these efforts are distinct, there are broad areas of commonality such as:

- Understanding the learning process, drawing on recognized learning theories
- Understanding students, including issues of intellectual and social development, learning styles and differences in student approaches to learning
- Introduction to instructional design, including both course and activity design
- Delivery systems, including an overview of teaching methods appropriate for different educational goals and environments, including both large and small classes and both face-to-face and distance or online education
- Making effective use of technology
- Designing and using appropriate methods to measure, assess, and evaluate student learning and engineering performance
- Engaging in reflective practice and continuous learning

These common focus areas of existing faculty development efforts can be used to guide development of a broadly recognized core of competency areas for EET faculty. As a fundamental aspect of the SPEED program, these competencies would be articulated at distinct levels to promote the continuous development of faculty.

Levels of Professional Development

The SPEED program would be open to all interested engineering educators as part of their ongoing professional development whether they are newly appointed faculty or established academics. Additionally, post-docs or Ph. D. candidates who wish to embark on a career path that will involve educating others could participate in a SPEED program. Long term, we conceive the SPEED programs to consist of three levels of competencies and related experience to be gained.

- Level 1 is concerned with introducing participants to the Foundations of Teaching and Learning.
- Level 2 is concerned with applying the competencies gained at level 1 and getting engaged with scholarly literature on educational practice. Here, participants become scholarly educators.
- Level 3 is concerned with fostering faculty development, mentoring, and contributing to the scholarship of educational practice.

At all three levels, participants will be required to create a portfolio documenting their activities and providing evidence of achievements as professional educators. In order to do so, participants need to become active reflective practitioners. They will learn how to reflect on their own work as well as that of others.

The content for the various SPEED levels is still evolving and will include ample opportunities for community involvement. Tentatively, however, level 1 content (based on a literature survey) is likely to include the following areas:

- Learning Theory: A practical overview of theories of learning and teaching in Higher Education, with a focus on the EET disciplines. This includes an overview of current cognitive and constructivist learning theories with a focus on their application to undergraduate instruction.
- Student Development: An introduction to understanding elements of student development which impact teaching and learning such as students intellectual and social development, learning style preferences and approaches to learning.
- Instructional Design: An introduction to the theory of constructive alignment (of intended learning outcomes, learning and teaching methods and assessment) to be used in course and activity design.
- Instructional Delivery Methods: An overview of facilitation techniques that might be employed in large group or small group teaching situations and face-to-face or distance environments, with an emphasis on approaches that might shift the environment of the classroom from teacher-centered instruction toward student-centered learning.
- Instructional Technology: An introduction to available tools and the effective use of technology to promote learning, including principles of e-learning.
- Assessing and providing feedback to learners: Purpose of assessment, principles of assessment, formative and summative assessment, methods of assessment, assessing groups, peer and self-assessment, devising assessment criteria, providing feedback.
- Reflecting on learning and teaching: An introduction to the role of reflection in professional practice.

Associated performance criteria will be developed through specific design activities outlined in and will be tied to specific metrics. In this regard, we are looking at a set of metrics via the identification of performance criteria similar to those identified from the literature. These metrics will then be applied to each level as appropriate. Not all levels will include all performance criteria. However, there will be some overlap where key criteria apply to more than one level. In these cases, progressively increasing scores will be required according to the increasing level of competence expected at each level.

SPEED Program Design, Implementation and Assessment

During the preparatory stage for implementing a SPEED program, we seek to (a) validate acceptance of the core performance criteria and outcomes of the SPEED content development process, (b) validate interest and incentives for participation in the SPEED program among the target populations (e.g., new engineering faculty), (c) validate operational and logistical assumptions for the SPEED Program, and (d) match the capabilities and interests of potential members of the SPEED Provider Network to the actual requirements for national SPEED implementation.

Results of the SPEED content development process will include core performance criteria, outcomes, and metrics; implementation mechanisms; and the design of the ASEE recognition process. Various focus groups including engineering deans and other members of a SPEED Advisory Council will work to validate these approaches. Initial conversations on content will occur through the presentation of this paper at the ASEE Annual Conference and subsequent educational-oriented conferences. Special outreach to various disciplinary engineering societies (e.g., American Institute of Chemical Engineers (AIChe), American Society of Mechanical Engineering (ASME), Society of Manufacturing Engineers (SME), Institute of Electrical and Electronics Engineers (IEEE), etc.) will occur as well.

The SPEED Level 1 Program will be implemented as a pilot at two locations: The University of Michigan and Georgia Tech – Savannah. These two institutions represent two distinct models – one is a large research university with a well-established office for engineering faculty development (The Center for Research on Learning and Teaching North), and the other is a smaller regional campus which can draw from the Georgia Tech Center for the Enhancement of Teaching and Learning and will connect with multiple feeder and companion institutions through a distance learning environment. This will allow design of SPEED implementation models appropriate to an array of delivery sites. Two Design Summits will bring together potential participants in the SPEED Level 1 Program pilots, potential providers, local senior faculty, and local chairs and deans. The Design Summits will serve to (a) validate incentives for participation by individual faculty (e.g., waived ASEE membership fees and/or waived ASEE conference fees), (b) select a subset of the identified performance criteria for delivery in an on-campus pilot, and (c) select the desired pedagogy (here referred to in a general sense not intended to exclude concepts of adragogy which directly address adult learners) and delivery mechanisms for the on-campus pilot. Following the Design Summits, the SPEED project team, advisory council, and program providers at the pilot sites will meet at the ASEE annual conference to finalize plans for the SPEED Level 1 Workshop pilots.

Operational and logistical assumptions for SPEED workshops will be validated via an initial pilot delivery of SPEED Level 1 Programs at the two partner sites with a target population of five faculty workshop participants at each site. These pilots allow the SPEED team to monitor implementation issues prior to full-scale implementation the following year. Following assessment of the pilot administration of the SPEED Level 1 Program and incorporating input from SPEED Feedback Summit at the ASEE Annual meeting, the full SPEED Level 1 workshop Program will be administered at each of the partner sites. These programs will seek to have target populations of 20 faculty workshop participants at each site will allow for further operational refinement of SPEED delivery models. The results of the pilot and full scale SPEED

Level 1 Program implementation will be shared with various campus-based, regional, and national workshop providers at the SPEED Feedback Summits to identify and select providers with the interest and capabilities to serve as members of a SPEED Provider Network. That Network will offer the SPEED Level 1 Workshop nationally to interested faculty in a follow-on year.

Engaging Constituencies and Creating Buy-in

The SPEED program, when implemented as a national model, will be transformative. EET faculty members will be able to engage in a more comprehensive design of their courses, from materials used to pedagogy employed. They will be better equipped to use information already available in the educational arena. It is likely this will engender more requests for funding on educational projects and the scholarship of teaching will be held in higher esteem by SPEED participants. None of this will happen, however, without having proper buy-in and commitment from the various constituencies affected.

The major constituencies impacted by the SPEED program will be students, faculty, administrators and industry. All of these constituencies have both unique and overlapping goals. Accordingly, our strategy is to engage them directly, with both general approaches and more specific interactions.

Faculty and administrative engagement on SPEED has already begun. The 2009 ASEE Annual Conference and Exposition included a paper introducing the SPEED program to the general ASEE community[1]. Refinement of the SPEED program will be presented, through this paper, at the 2010 ASEE Annual Conference as well as at the ASEE-Southeast Sectional Conference[10]. Liaisons have already been identified from important groups such as the Engineering Deans Council and Engineering Technology Council specifically directed to the SPEED activity. Invited speakers are already being gathered to present at a mini-plenary session at the 2010 ASEE Annual Conference. A special SPEED Advisory Council is already in place which represents some of the most respected minds in engineering education.

The first major dissemination point to present the implementation details of SPEED, including specific performance criteria for the SPEED program as well as the logistical details associated with implementing a SPEED program at the Pilots, will be during a future ASEE Annual Conference. Feedback will be encouraged at this point and could influence various aspects of the Pilots (which are to begin in the fall of that year). After this milestone point, continued engagement will occur with the academic community through presentations at future ASEE Annual Conferences as well as Sectional/Zone ASEE meetings. Additionally, we will work with the Professional Interest Council Chairs at ASEE to disseminate information on the SPEED program to the ASEE Divisions. Also, educational divisions/committees of technical societies within engineering, such as ASME, AIChE, IEEE, etc. will be contacted as well. Note that in all of these interactions, feedback will be requested and expected.

Industry is the end-user of the product leaving EET departments: students. Accordingly, industry engagement is an important element of the SPEED program. To this end, industry will be engaged through interactions with the Corporate Membership Council of ASEE.

Administrative buy-in is a key to the SPEED program since, ultimately, deans and chairs will need to support the activity. A commitment of resources to participate in SPEED as well as an explicit commitment to educational activities (through promotion and tenure requirements, for example) is needed. To this end, we will run an Administrative Track of SPEED which does not focus in detail on the content of the program, but on the benefits to faculty and colleges that SPEED participation can provide.

The Administrative Track of SPEED would be in workshop format and the plan is to deliver this each year at the ASEE Annual Conference. However, a first round of an Administrative Track of SPEED will occur at the two pilot locations during the Design Summit for administrators. Lessons learned from these sessions, including critical and constructive feedback from administrators on both content and benefit, will be used to modify the information presented at the ASEE Annual Conference workshop.

Engagement of students in SPEED will occur through student committees of technical organizations such as AIChE, ASME, SME, IEEE, etc. Specific information about SPEED will be disseminated to these groups, who will then provide this information to local student chapters. In particular, we will share selected literature on educational reform in engineering and the benefits to students when faculty utilize appropriate pedagogy. We will describe the objectives of the SPEED program and highlight the strengths that faculty will possess once they have achieved the various SPEED levels. We will ask for feedback from those national student organizations as well as provide a means for students to provide feedback through a website. In particular, we will be interested in whether we have missed a consensus or universal concern of the student constituency and, if so, will attempt to incorporate this into SPEED.

Concluding Remarks

This paper provides a discussion, with some specific detail, on the ASEE-supported SPEED program plans. We have presented the rationale for such a program, certain critical elements of SPEED, and discussion on content and logistics as well as plans for engaging constituencies. We present information on two planned pilot locations: the University of Michigan and Georgia Tech-Savannah. The design and development of specific implementation plans, program content, assessment strategies, and evaluation for SPEED is on-going.

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