Program Description

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Introduction

Faculty development is one pivotal strategy for improving engineering education in the United States, because engineering faculty members make all decisions about engineering curricula: what should be taught, how it should be assessed, how it should be taught, and when it should be taught. Curricular change initiatives can offer alternatives to current practice in engineering education, but engineering faculty members at each institution make decisions regarding uptake (or not) of these curricular initiatives. If engineering faculty members continue thinking about engineering education in the same ways they have thought about it for the past 50 years, significant improvements in engineering education are unlikely. The American Society for Engineering Education (ASEE) has offered a three-day faculty development workshop for about 50 engineering faculty members each year since 1991, and there are currently over 1100 alumni of the program. The American Society of Civil Engineers has had six-day faculty development workshops, each limited to 24 participants, since 1999, and there are over 500 alumni of the ASCE workshops.

National Effective Teaching Institute 2012.

What is the size of the engineering education enterprise?

Faculty development is often mentioned as one of a set of approaches that should be pursued to improve engineering education across the country (Froyd, Beach, Henderson, & Finkelstein, 2008; Froyd, Layne, & Watson, 2006). Change initiatives must be planned, designed, and implemented with understanding of the magnitude of the intended change. To provide background on the size of the engineering education enterprise that is the focus of continuing efforts to improve engineering education, Table I provides numbers of engineering faculty members at various ranks in 2010, student enrollment, and numbers of degrees awarded in the United States.

Table I. Numbers of Engineering Faculty and Students in the United States in 2010.

Category	Number
Tenured/tenure-track faculty	24,435
Professor	12,179
Associate professor	6,896
Assistant professor	5,360
Non-tenure-track faculty	2,781
Undergraduate enrollment (2009-2010)	450,685
Bachelor's degrees (2009-2010)	78,347
Master's degrees (2009-2010)	43,023
Doctoral degrees (2009-2010)	8,995

To change the way engineering is taught at the undergraduate level, a significant fraction of the over 24,000 tenured/tenure-track faculty members and over 2700 non-tenure-track faculty members must change how they teach engineering courses. Faculty development has a role to play in promoting that change.

Two Engineering Faculty Development Workshop Initiatives

Two engineering professional societies have offered faculty development workshops for several years. The American Society for Engineering Education (ASEE) has offered the National Effective Teaching Institute (NETI) since 1991, and the American Society of Civil Engineers (ASCE) has offered the Excellence in Civil Engineering Education Teaching Workshop (ExCEEd) since 1999.

National Effective Teaching Institute (NETI)

The National Effective Teaching Institute (NETI) is a three-day workshop offered annually just before the ASEE Annual Conference & Exposition (Felder & Brent, 2009, 2010). Since 1991, when it was first offered, ASEE program staff invites all deans of engineering and engineering technology in the U.S. to nominate up to two of their faculty members. Invitations are sent in January, approximately five months before NETI is offered. The number of workshop participants is limited to 55, and applications are accepted on a first-come, first-served basis. NETI is sponsored by the Engineering Research and Methods and Chemical Engineering Divisions of the ASEE. Currently, participants' institutions pay the cost of the workshop ($950 in 2012) and expenses for participants. With this cost structure, NETI is self-sustaining.

Topics that are the major focus of NETI are the following:

- Student learning styles (Felder & Silverman, 1988)
- Writing learning objectives (Felder & Brent, 1997; Mager, 1997)
- Planning courses

- Active learning (Bonwell & Eison, 1991)
- Cooperative learning (Felder & Brent, 1994; Johnson, Johnson, & Smith, 2006)
- Effective lecturing
- Assessment of learning
- Teaching problem-solving skills
- Dealing with a variety of problems that commonly arise in the careers of engineering instructors

"For each topic addressed in the workshop, practical suggestions are offered and the research attesting to their effectiveness is cited and discussed" (Felder & Brent, 2009). Faculty issues are addressed on the second day of the workshop in two concurrent 90-minute sessions. One session addresses challenges faced by relatively new faculty members on getting academic careers off to a good start (Boice, 2000); the second concurrent session focuses on more experienced faculty members and how they can promote effective teaching on individual campuses. In addition to these major emphases, topics that are addressed, but receive less emphasis include the following:

- Inquiry-based learning
- PowerPoint
- Problem-based learning
- Web-based tutorials
- Distance education

Effectiveness of NETI, like all faculty development programs, can be evaluated at three levels (Chism & Szabo, 1998):

- **Level 1:** How satisfied were the participants with the program?
- **Level 2:** What was the impact of the program on the participants' teaching practices and on their attitudes toward teaching and learning?
- **Level 3:** What was the impact of the program on the participants' students' learning?

For the first level, NETI facilitators administered a survey at the conclusion of every workshop. Through 2012, NETI has had 1148 participants from 230 different institutions (Felder, n.d.). Responding participants have provided the following summative evaluations:

- **Excellent:** 801
- **Good:** 221
- **Fair:** 1
- **Poor:** 0 (Felder, n.d).

To evaluate NETI at the second level, Felder and Brent sent surveys to 607 NETI alumni (1993-2006) with valid email addresses. They received 319 completed surveys (53% response rate). To evaluate how participants have changed their teaching, the survey asked respondents how frequently they applied teaching practices described in the workshop. Figure 1 summarizes responses for five of the major NETI foci.

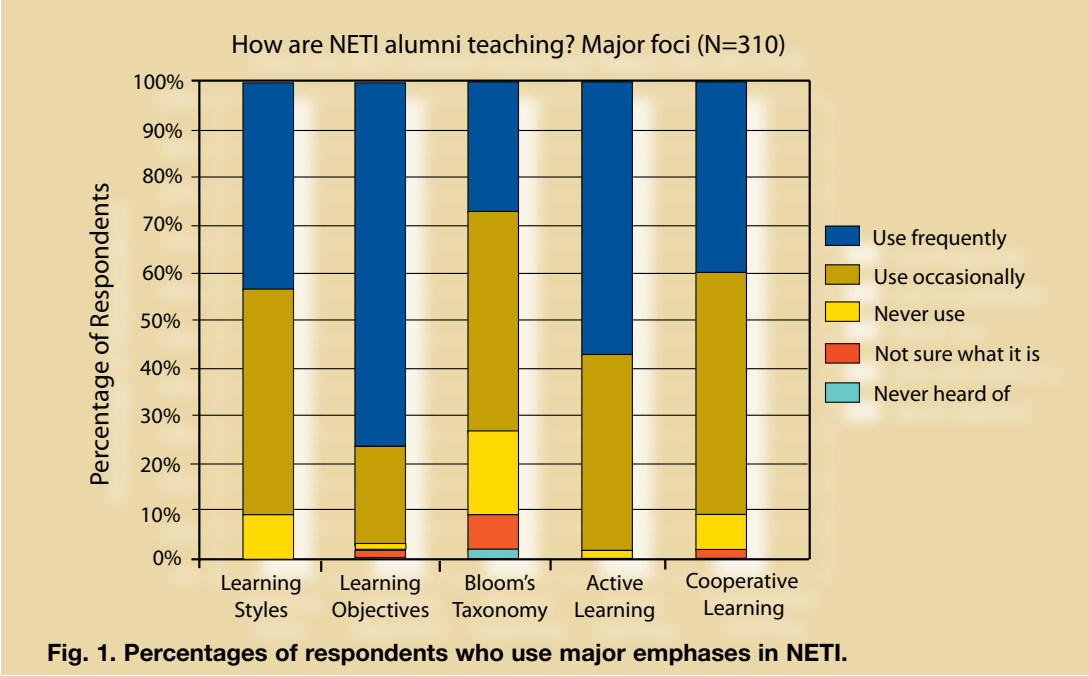

Fig. 1. Percentages of respondents who use major emphases in NETI.

The most frequently used teaching practice emphasized in the workshop is the formulation of learning objectives, reported by 775 of the respondents to be used frequently. The teaching practice that had the lowest percentage of frequent use (27%) is Bloom's taxonomy (Anderson & Krathwohl, 2001; Bloom, Englehart, Furst, Hill, & Krathwold, 1956). Only small percentages of the respondents reported that they had never heard about or were unsure of what these five major emphases were (Felder & Brent, 2010).

One way to check on validity of these responses is to examine respondent use of teaching practices that were minor foci of NETI. Since these were minor foci, expected adoption of practices related to the minor foci would be lower than adoption of those related to major foci. Adoption of teaching foci related to minor workshop foci is summarized in Fig. 2.

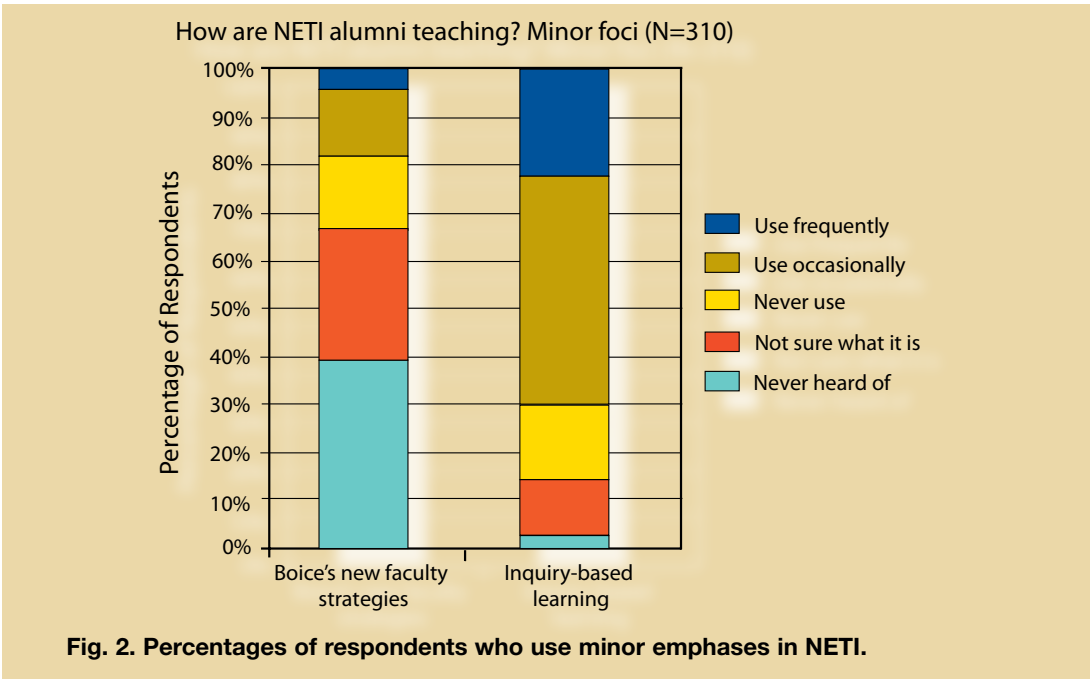

Fig. 2. Percentages of respondents who use minor emphases in NETI.

Examination of these responses shows less frequent use and more unfamiliarity and uncertainty about two topics (Felder & Brent, 2010), when compared to practices related to major foci. Survey respondents were also asked to respond to questions about the degree to which NETI has influenced their teaching practice. Percentages for five major and two minor emphases are shown in Figs. 3 and 4, respectively.

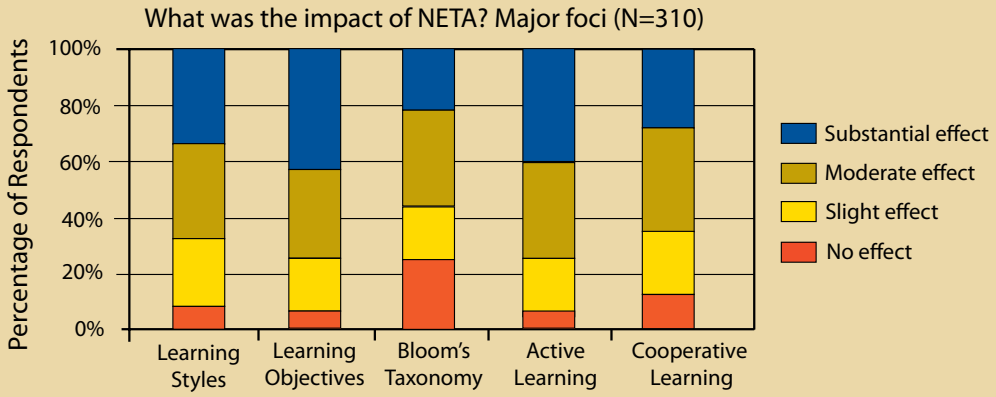

Fig. 3. Influence of major emphases of NETI on teaching practice.

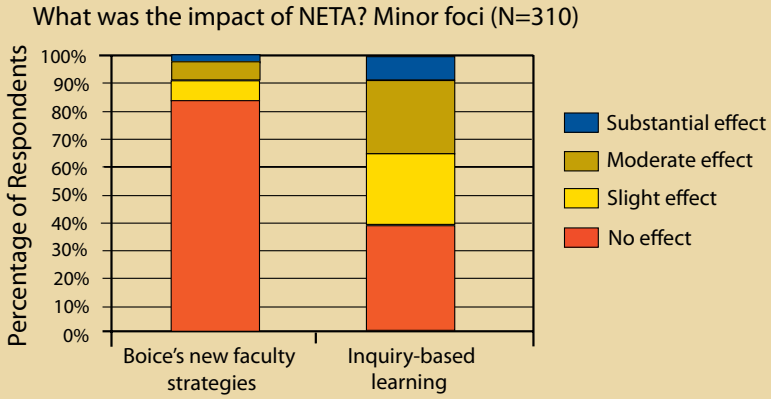

Fig. 4. Influence of minor emphases of NETI on teaching practice.

Over 50% of the survey respondents indicated that their participation in NETI had a substantial or moderate effect on their teaching in each of the five major emphases that were included in the survey. Less than 40% indicate that two minor emphases have influenced their teaching. So, participants reported the major emphases in NETI affected their teaching, but the minor emphases had a noticeable less effect.

Since nearly every recent NETI workshop has exceeded or nearly exceeded capacity, and since participant responses have been so positive, consideration of additional NETI offerings is reasonable. Starting in July 2012, ASEE program staff will invite deans to nominate faculty members to participate in a similar three-day workshop that will be offered in the following January. The workshop that has been offered in June (just prior to the ASEE annual conference) will be referred to as NETI-1A, and the January offering will be referred to as NETI-1B. Also, starting in October 2012, ASEE will

offer NETI-2, which is intended for both NETI-1 alumni as well as engineering faculty members who have acquired similar knowledge and practice through other avenues. NETI-2 will emphasize two teaching approaches: cooperative learning (Felder & Brent, 1994; Johnson, et al., 2006) and inductive teaching (e.g., problem-based learning, project-based learning, challenge-based learning) (Prince & Felder, 2006, 2007; Roselli & Brophy, 2006).

Excellence in Civil Engineering Education Teaching Workshop (ExCEEd)

The Excellence in Civil Engineering Education Teaching Workshop (ExCEEd) is a six-day workshop that has been offered by ASCE since its initial offering in 1999 at the United States Military Academy (Welch, Baldwin, et al., 2001; Welch, Hitt, et al., 2001). Each workshop offering is limited to 24 participants to provide multiple opportunities to apply the knowledge and skills they are acquiring. Invitations are sent to civil engineering (and related) departments across the country and faculty members apply. Currently, participants' institutions pay part of the cost of the workshop ($425) and participants' expenses, while ASCE invests $2075 for each participant to cover the $2500 per participant cost (American Society of Civil Engineers, 2012). With this cost structure, ExCEEd has been self-sustaining.

By summer 2010, 25 workshops had been delivered with approximately 545 alumni from over 200 different U.S. and international colleges and universities (Larson, Estes, Dennis, Welch, & Considine, 2010). At least four institutions have hosted ExCEEd workshops: United States Military Academy, University of Arkansas, Northern Arizona University, and University of Colorado, Boulder.

Topics covered in an ExCEEd workshop (Quadrato, Welch, & Albert, 2005) are listed below:

- Principles of effective teaching and learning
- Learning styles
- Communication skills
- Learning objectives
- Class organization and course organization
- Development of interpersonal rapport with students
- Teaching with technology
- Classroom assessment techniques

However, this list of topics fails to capture the essence "of this hands-on, learning-by-doing workshop" (Larson, et al., 2010). A crucial feature is that ExCEEd participants have three opportunities to practice what they are learning and receive feedback on their teaching. Participants prepare and teach three actual (although shorter than the traditional 50-minute period) classes in small-group settings. These practice sessions have been highlighted as valuable learning opportunities in workshop participant surveys. In addition to the practice sessions, participants also watch demonstration classes, which are models of high-quality teaching, presented by ExCEEd faculty mentors. Content, philosophy, and teaching approaches have been described in several papers on ExCEEd (Estes et al., 2008; Estes, Welch, & Ressler, 2005, 2006; Larson, et al., 2010; Quadrato, et al., 2005; Welch, Baldwin, et al., 2001; Welch, Hitt, et al., 2001; Welch, Ressler, & Estes, 2005).

ASCE conducted a survey of ExCEEd participants in 2007. One hundred twelve (112) faculty members responded to the survey (28% response rate) (Estes, et al., 2008). In response to a question "Would you recommend the ETW to a new faculty member in your department?" 93% of the respondents chose "Absolutely" over "Probably," "Neutral," "Probably Not," and "Absolutely Not," The other 7% chose participants chose "Probably." When asked about its important to their personal growth as a teacher, 43% said it was "Essential" and 46% said it was "Important" (Estes, et al., 2008). The survey also provided data about the need for a second workshop.

In response to requests for a more advanced workshop, ASEE began offering ExCEEd II, a day-and-a-half workshop, in 2009 at Northern Arizona University (Larson, et al., 2010). Learning objectives for ExCEEd II focused on a review of ExCEEd I, how learners develop from novices to experts, best practices in distance education, project-based learning, managing teams, large classroom techniques, and dealing with difficult students. It also featured a demonstration class, taught by a master teacher of the ExCEEd method, on introductory probabilistic design (Estes, et al., 2008).

Conclusions

To date, almost 1700 engineering faculty members have participated in faculty development workshops offered either by ASEE or ASCE. Using engineering faculty numbers from Table I, over 6% of the engineering professoriate has participated in a faculty development workshop sponsored by these two professional engineering societies. Participant responses indicate overwhelming satisfaction with the workshops, and the NETI survey results suggest that participation has influenced teaching practice.

A search of the literature on engineering faculty development did not find that the other professional engineering societies, for example, the Institute of Electrical and Electronic Engineers, the American Society of Mechanical Engineers, or the American Institute of Chemical Engineers, offered faculty development workshops on a regular basis.

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