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The ASCE ExCEEd Teaching Workshop: Assessing 20 Years of Instructional Development*

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The Excellence in Civil Engineering Education (ExCEEd) Teaching Workshop (ETW), a week-long teacher-training program sponsored by the American Society of Civil Engineers, has been improving the quality of university teaching for twenty years. The 41 workshops conducted over this period have produced 963 graduates from 253 universities around the world. This article celebrates the history of this landmark faculty development initiative. It assesses the extent to which the ETW provides a unique contribution and has influenced teaching practices in U.S. civil engineering programs. This assessment includes participant satisfaction, the long-term influence on participants, the influence on those participants who became ETW faculty leaders, the satisfaction of the deans and department heads who sponsored the participants, the scholarship that has resulted from the ETW, and the implied influence on the engineering students who ultimately benefit

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from this workshop. Finally, the future direction of the ETW is addressed. Although the workshop is intended primarily for civil engineering programs in the U.S., the results of this study are also highly relevant to other engineering disciplines and to engineering programs outside the U.S.

Keywords: faculty development; teaching effectiveness; instructional development; workshop assessment; ExCEEd; teacher training; civil engineering education

1. Introduction

In 1998, the American Society of Civil Engineers (ASCE) launched a major faculty development initiative called Project ExCEEd—Excellence in Civil Engineering Education. In July of the following year, implementation of this project began with the first ExCEEd Teaching Workshop (ETW), an intensive five-day faculty development experience designed to provide participants with the knowledge, skills, and motivation to become effective teachers. Over the succeeding 20 years, the ETW has grown, evolved, and continuously improved, while producing consistently positive outcomes. The 20th year of the ETW is an appropriate milestone for documenting the history of this program, assessing its implementation and impact, and charting its future course to provide other engineering disciplines a possible framework for effective faculty development.

2. Purpose and scope

In recent decades, as cognitive science has provided increasingly valuable insights about how people learn, educational research [1–3] has demonstrated the effectiveness of instructional strategies and teaching methods derived from these scientific insights. Such evidence-based teaching practices include the use of learning objectives and a variety of alternatives to traditional lecture-based instruction, including active and collaborative learning, experiential learning, and inquiry-based educational experiences. The research also indicates these same teaching practices will have limited positive effect on student learning if implemented by faculty with little to no training in these methods [4, 5] and recommends the implementation of faculty development programs that provide faculty with demonstrations of best practices and opportunities to gain mentored experience in implementing these practices.

While the most direct application of this educational research is to improve student learning outcomes in the classroom environment, these insights are also fully applicable to *instructional development*—defined by Felder, Brent, and Prince as a subset of faculty development focused specifically on improving teaching effectiveness [6].

The ETW's unique five-day format—which includes three demonstrations classes, incorporates evidence based practices in the instructional development of the workshop, and provides mentored teaching experiences—is targeted at developing instructors with the necessary skills and motivation to implement these evidence-based teaching practices to improve student learning and engagement.

The ETW is a direct response to documented reports of poor teaching in the math, science, and engineering disciplines and the lack of adequate training in classroom teaching for faculty. Studying 335 students at seven diverse institutions, Seymour and Hewitt [7] concluded that poor teaching was the principal reason that many students left science, math and engineering (SME) programs in the U.S. and that poor teaching was the largest concern among those students who stayed. Follow on studies [8, 9] have indicated that this problem still exists. While this paper might appear to narrowly focus on a single teaching workshop in a single discipline, the results of this study should be of great interest to other engineering disciplines and to engineering programs outside the U.S. that are struggling with these same challenges of poor teaching and lack of available teacher training.

The purposes of this paper are to document the design, implementation, and evolution of the ETW during its first two decades of existence and to present the results of a comprehensive assessment aimed at addressing the following research questions:

(1) To what extent does the ETW reflect a unique contribution to the design of engineering faculty development workshops?
(2) To what extent has the ETW influenced teaching practices in U.S. civil engineering programs?
(3) What should be the future direction of the ETW?

To address these questions, we first describe the historical development and instructional design of the ETW. We then present a comprehensive assessment of the workshop, based on a large quantity of data collected from ETW participants, ETW faculty, civil engineering department heads, and engineering deans. Our analyses of these data serve as the basis for recommendations regarding the future direction of Project ExCEEd.

3. Research on the design and effectiveness of teaching workshops

Despite the well-documented effectiveness of evidence-based teaching practices, engineering programs have been slow to embrace these methods. A particularly ambitious effort to overcome engineering educators' reluctance to adopt evidence-based teaching practices can be seen in the faculty development program created and implemented by SUCCEED—the Southeastern University and College Coalition for Engineering Education—which was funded by the Engineering Education Coalition program of the National Science Foundation (NSF) from 1992 to 2002. The objectives of this faculty development initiative were (1) to promote the adoption of instructional methods that have been proven effective by classroom research; (2) to improve institutional support for teaching at each of the coalition's eight campuses; and (3) to implement a sustainable engineering faculty development program on each campus by the conclusion of the grant. The scope of the SUCCEED faculty development model was quite comprehensive, as its main elements included not only engineering-specific teaching workshops, but also linkages to campus-wide faculty development programs, institutional incentives for high-quality teaching, establishment of learning communities, mentoring programs, teaching orientations for new faculty and graduate students, and graduate coursework in teaching. Given its breadth and on-campus focus, the SUCCEED model was also quite flexible, allowing each coalition member to implement selected elements of the model in ways that would meet each institution's unique needs [10].

A typical example of a SUCCEED teaching workshop for new engineering faculty was offered at North Carolina State University in August 2000 [11]. The workshop was five days long, with two days focused on effective teaching and advising, two days devoted to research program setup and management, and one day for miscellaneous campus-specific topics (e.g., campus culture, tenure and promotion). The two-day teaching effectiveness segment covered learning styles, course planning, writing tests, effective lecturing, active learning, and technology-based course delivery.

Implementation and assessment of the SUCCEED faculty development program yielded two findings that are particularly significant to this paper:

- According to Brent et al., "most faculty development personnel come from backgrounds in education or the social sciences, and so are not prepared to use the terminology and provide the concrete examples that would convey a sense of relevance to the engineers." [7] Thus, to be successful, engineering faculty development programs should be taught or facilitated by engineers.
- In a comprehensive survey of engineering faculty at SUCCEED institutions, self-reported adoption of evidence-based teaching methods correlated strongly with attendance at teaching workshops and seminars [10]. Moreover, 59% of respondents reported that they either began or increased their use of active learning as a direct result of their participation in a workshop. Similarly, 43% attributed their use of both instructional objectives and team-based learning to workshop participation. In short, the SUCCEED survey demonstrates that workshops are particularly effective in influencing faculty members' willingness to use new evidence-based teaching methods.

Although the SUCCEED faculty development program achieved significant successes, its influence outside of the eight coalition schools appears to have been far more limited. Felder et al. report that, despite increasing availability of suitable faculty development programs, most new faculty members still learn their jobs by trial and error [9]. Indeed, studies by Boice indicate that 95% of new faculty members (in all disciplines) in the U.S. achieve proficiency in both teaching and research primarily through trial and error, typically over the course of four to five years [13].

To provide an instructional development opportunity for engineering faculty who were not involved in the Engineering Education Coalition program, Stice and Felder established the National Effective Teaching Institute (NETI), which was first offered in conjunction with the 1991 American Society for Engineering Education (ASEE) Annual Conference. NETI is a three-day workshop, the goals of which are to improve participants' teaching effectiveness, promote their engagement in educational scholarship, and motivate them to engage in instructional development on their campuses [14].

Today, the basic-level NETI workshop (now called NETI-1) has been offered annually for 27 years, and 1,312 faculty members from 244 different schools have participated to date [15]. As demand has increased, the program has expanded to include two NETI-1 workshops per year and, since 2012, a two-day advanced-level workshop called NETI-2 [16].

The current program of instruction for NETI-1 includes the following topics [17]:

- Motivating students and student learning.

- Writing and using learning objectives.
- Active learning techniques.
- Inclusive pedagogies.
- Using inductive teaching methods (inquiry-based, problem-based learning, and project-based learning).
- Assessment of learning.
- Getting your faculty career off to a good start.
- Promoting effective teaching on your home campus.
- Crisis clinic.

Seminars on these topics are taught in an engaging manner, with frequent small-group activities and opportunities for discussion. The workshop culminates with a hands-on course planning exercise. The workshop facilitators are nationally prominent engineering educators with widely recognized expertise in teaching, learning, human development, and educational research.

A rigorous long-term assessment of NETI-1 has demonstrated that the workshop has been successful in motivating participants to adopt or increase their use of evidence-based teaching methods; making them more student-centered, scholarly, and reflective in their teaching practice; and inducing many of them to engage in instructional development and educational scholarship [14].

Drawing upon their experience with NETI, Felder, Brent, and Prince have identified best practices and provided recommendations for the design and delivery of engineering instructional development programs [6]. This comprehensive analysis includes:

- Options for program content, including discussion of whether programs should focus on teaching techniques, science-based learning theories, or broader human development issues.
- Possible instructional development program structures, including the relative merits of campus-wide vs. discipline-specific programs, external vs. local program facilitators, and mandatory vs. voluntary participation.
- A model for assessing these programs.
- A research-based framework for the design of these programs.

The following aspects of Felder, Brent, and Prince's study are particularly relevant to this paper:

- Engineering faculty members typically expect teaching workshops to address their immediate need for practical techniques. Nonetheless, coverage of teaching tips and strategies should be balanced by higher-level theories of human learning and development, because tips and strategies learned in one context often do not transfer to new contexts, while higher-level theories are more broadly applicable.
- A particularly powerful paradigm for organizing the content of a workshop is to use an *inductive approach*—first addressing "nuts and bolts" techniques, then introducing higher-level concepts about human learning and development.
- Workshops like NETI, which are not affiliated with a particular campus or institution and thus are accessible to all, offer the greatest potential *breadth of impact*. However, when offered as one-time events, these workshops often do not have a lasting impact, because participants' good intentions do not translate into meaningful changes in teaching practice when they return to their home institutions.
- The most important advantage of engineering discipline-specific workshops is that their presenters better understand the participants' needs, interests, and problems. Thus, the presenters have more credibility and can target their approach to the unique needs and challenges of teaching engineering courses.
- A good basis for the design of engineering instructional development programs is the model proposed by Wlodkowski [18]. According to this model, adult learners are best motivated by a learning environment with five key attributes—expert presenters, relevant content, choice in application (i.e., no "one size fits all" prescriptions), *praxis* (i.e., opportunities for participants to try new methods themselves and then reflect upon the outcomes), and group work.

These observations, published twelve years after the development of the ASCE ETW, provide a powerful affirmation of the workshop's instructional design.

4. History of the ExCEEd workshop

In the 1980s and 1990s, ASCE conducted a Civil Engineering Education Conference once every five years, for the purpose of identifying major challenges in civil engineering education and proposing educational reforms and initiatives to address these challenges. At the 1995 Civil Engineering Education Conference, 235 participants considered a wide range of issues and collectively identified four major areas for focused action by ASCE: (1) faculty development, (2) an integrated curriculum, (3) practitioner involvement in education, and (4) the first professional degree [19].

Following the 1995 conference, the ASCE Educational Activities Committee (EdAC) assumed responsibility for the faculty development issue area. EdAC proposed to the ASCE Board of Direction that a standing Committee on Faculty Development be established and funded to plan and implement a teaching effectiveness workshop for civil engineering faculty. This proposal was reinforced through a visioning process conducted by EdAC in 1998.

That year, the vision became a reality as the ASCE Committee on Faculty Development (CFD) was established as a constituent committee of EdAC. CFD was charged with planning and implementing a comprehensive faculty development initiative, which would include the development of teaching effectiveness workshops and seminars, faculty recognition programs, and a directory of information resources for engineering faculty development [20]. This initiative—named Project ExCEEd—was funded at $150,000 annually for fiscal years 1999 and 2000.

At its initial meeting in November 1998, CFD gave priority of effort to the development of a teaching effectiveness workshop, which was to be offered just eight months later in the summer of 1999 [21]. To design this workshop, CFD first examined a range of existing faculty development programs, including:

- The National Effective Teaching Institute (NETI), described above.
- The Teaching Teachers to Teach Engineering (T^4E) Workshop, a five-day short course developed by faculty from the U.S. Military Academy (USMA) at West Point, funded by the National Science Foundation (NSF), and offered annually at USMA from 1996 to 1998 [22].
- Faculty development workshops developed by the Foundation Coalition—another of the NSF-funded Engineering Education Coalitions.
- A mentorship program developed for doctoral candidates at Virginia Tech.

Of these alternatives, CFD determined that the T^4E workshop format was most consistent with the goals of Project ExCEEd, particularly because of its strong focus on improving teaching performance through small-group learning, practice classes, and individualized feedback.

Given the limited time available, CFD decided that the design of the 1999 ExCEEd Teaching Workshop would be based on the T^4E model and that the T^4E team at USMA would be charged with planning and implementing this first edition of the ETW. However, recognizing that the T^4E model might need to be adapted to meet ASCE's long-term needs for Project ExCEEd, CFD also decided that the inaugural ETW would be rigorously assessed by an independent team of experts, who would then make recommendations for the design of future ETW editions.

The mechanism for performing this assessment was the Program Design Workshop (PDW), implemented by a team of nine consultants selected by CFD through an open application process. The PDW met at West Point in July 1999, concurrent with the inaugural ETW. PDW members observed the ETW's key learning activities, met with ETW faculty and participants, and reviewed participants' end-of-workshop assessments. The team then prepared a scholarly report documenting its findings and recommendations. This report validated the fundamental instructional model embodied in the original ETW but recommended several substantive changes to the workshop structure and content to enhance its effectiveness, transportability, and sustainability [23]. The report included an implementation plan for organizing, resourcing, conducting, and assessing future annual ETWs at multiple sites.

The long-term effectiveness of this plan is evident in Table 1, which summarizes all of the ASCE ETWs conducted from 1999 to the present and shows the sources of funding for each year. During twenty years of running Project ExCEEd, ASCE has conducted a total of 41 workshops at seven different host institutions. Of the 963 faculty members who participated, 952 were from U.S. institutions, while the others were from universities in Ireland, Colombia, Hong Kong, South Africa, Canada, Spain and Afghanistan. Because of the ETW's strong emphasis on practice and individualized feedback, most of these workshops could accommodate only 24 participants—even though all had significantly larger numbers of applicants, as indicated in Table 1.

ETW participants are selected through a formal application process administered by CFD. Applicants are asked to state their teaching philosophy, summarize their expectations for the workshop, and identify ways they will contribute to improved teaching at their home institutions after attending the ETW. A letter of support from each applicant's department chair or dean is also required. CFD reviews these applications and selects workshop participants, based primarily on their compatibility with the ETW goals and instructional focus. CFD also considers the applicants' years of teaching experience, previous applications, workshop site preference, number of applications from the same university, and whether the applicant's university has previously had a faculty member attend.

Over the past 20 years, 256 different institutions have sent faculty members to the ETW. The eleven universities with the largest numbers of ETW graduates are listed in Table 2. Given these institutions' high level of participation in Project ExCEEd, it is evident that the ETW represents an important

Table 1: Summary of all ASCE ETWs conducted from 1999 to the present

Year	Host Institution	# of Apps	Available Seats	Registration Fee	Stipend	Funding Source
1999	USMA	29	24	none	$600	ASCE
2000	USMA	76	24	none	$600	ASCE
	University of Arkansas		24			
2001	USMA	53	24	none	none	Bechtel
	University of Arkansas		24			
2002	Northern Arizona University	95	24	none	$250	Bechtel
	USMA		24			
	University of Arkansas		24			
2003	USMA	85	24	none	$250	Bechtel
	University of Arkansas		24			
	Northern Arizona University		24			
2004	USMA	68	24	none	none	UEF
	University of Arkansas		24			
2005	USMA	59	24	$425	none	Bechtel
	University of Arkansas		24			
2006	USMA	65	24	$425	none	Bechtel
	University of Arkansas		24			
2007	Northern Arizona University	81	24	$425	none	Bechtel
	USMA		24			
2008	USMA	92	24	$425	none	Bechtel
	University of Arkansas		24			
2009	Northern Arizona University	89	24	$425	none	Bechtel
	USMA		24			
2010	USMA	64	24	$425	none	ASCE Foundation
	University Of Colorado, Boulder		24			
2011	USMA	74	24	$425	none	ASCE Foundation
	University of Texas, Tyler		24			
2012	USMA	83	24	$425	none	ASCE Foundation
	Florida Gulf Coast University		24			
2013	Florida Gulf Coast University	92	24	$495	none	ASCE Foundation
2014	USMA	87	24	$495	none	ASCE Foundation
	Florida Gulf Coast University		24			
2015	USMA	96	24	$595	none	ASCE Foundation
	Florida Gulf Coast University		24			
2016	USMA	127	24	$650	none	ASCE Foundation
	Florida Gulf Coast University		24			
2017	USMA	120	28	$1,000	none	ASCE Foundation
	Florida Gulf Coast University		28			
2018	USMA	114	24	$1,000	none	ASCE Foundation, Univ. of Nebraska
	Florida Gulf Coast University		24			
	University of Nebraska		24			

Table 2. Universities with the largest numbers of ETW graduates

Institution	Grads
California Polytechnic University, San Luis Obispo	18
Texas A&M University	16
Texas Technological University	14
Clemson University	13
The University of Texas-Austin	13
Washington State University	13
Colorado State University	12
Florida Gulf Coast University	12
Southern Illinois University, Edwardsville	12
University of Arkansas, Fayetteville	12
Virginia Tech	12
TOTAL	**147**

contribution to civil engineering faculty development at these schools.

The distribution of workshop participants' teaching experience, shown in Fig. 1, has ranged from zero to over 20 years, with an average of 3.4 years. The large proportion of participants (42%) with one to three years of teaching experience appropriately reflects the workshop's focus on developing fundamental teaching skills. Approximately 30% of ETW participants have been women–substantially higher than the percentages of women in U.S. tenure-track faculty positions in civil engineering (18.9%) and environmental engineering (26.9%) [24].

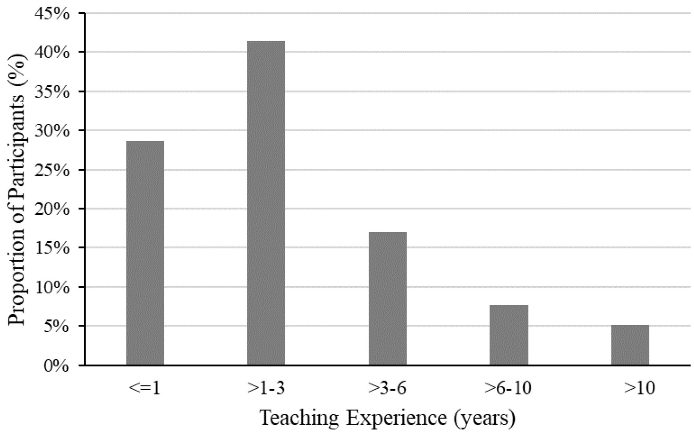

Fig. 1. ETW participants' teaching experience before attending the workshop.

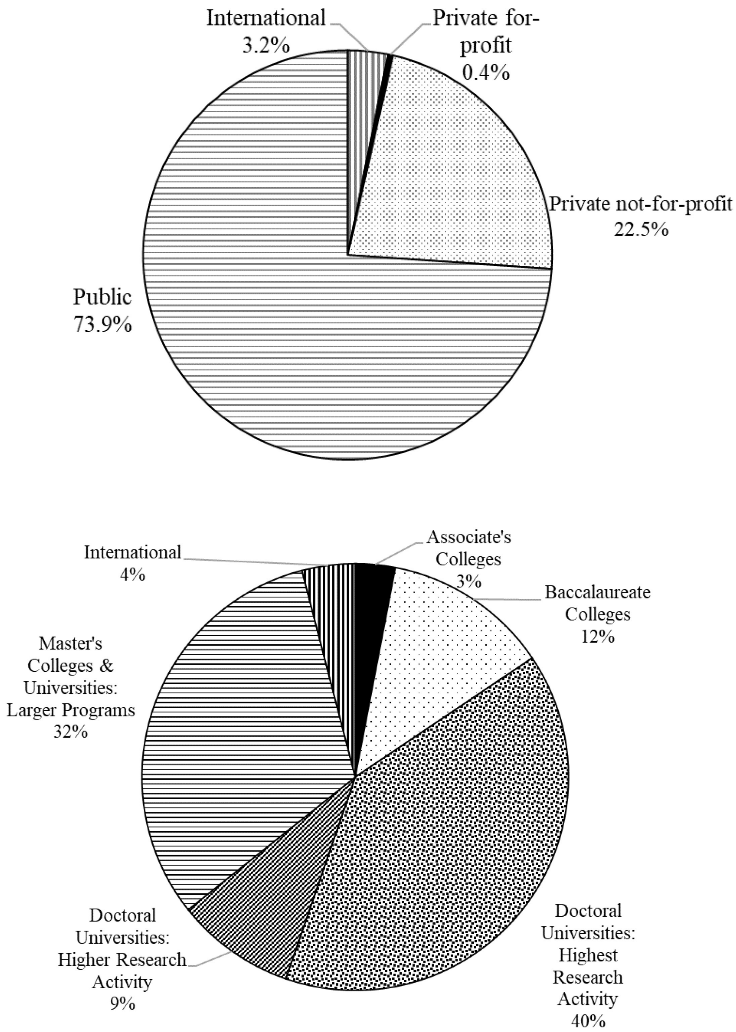

Fig. 2. Classifications of the universities that have sent participants to ETW.

Carnegie classifications of the universities that have sent participants to the ETW are shown in Fig. 2. Approximately three quarters of these schools have been public institutions, and almost half have been doctoral degree-granting schools.

5. Organization and content of the ExCEEd teaching workshop

Consistent with the primary goal of ASCE's faculty development initiative—improving teaching skills—the learning objectives of the ETW have been defined as follows:

- Explain what constitutes effective teaching.
- Apply Felder's learning styles model to the organization and conduct of a class.
- Use classroom assessment techniques to assess student learning.
- Organize a class.
- Deliver classroom instruction.
- Assess a class from a student's perspective.
- Self-assess your own class.

To achieve these objectives, the overall design of the ETW has been derived from a research-based conceptual model of the human learning process, developed by Apple et al. to enhance students' skills as self-learners [25]. As adapted for the ETW, this Model Instructional Strategy consists of eight major steps representing the critical elements of a high-quality learning experience, as illustrated in Fig. 3 [26]. During the workshop, this model is developed inductively by the ETW participants in a group exercise where they assume the role of learners. The model is then flipped, such that participants discover that the most effective way to teach is to accommodate how students learn best.

The structure of the ETW incorporates three types of learning experiences—seminars, demonstration classes, and labs—each of which fulfills a portion of the Model Instructional Strategy.

Seminars are the principal means of delivering content in the ETW. Each of these sessions is taught by a subject-matter expert to all workshop participants in a single room. Material for the ETW seminars is drawn primarily from references [7, 27–29], from NETI workshop materials (with permission), and from the broader peer-reviewed literature on teaching and learning. With respect to the Model Instructional Strategy, seminars are used to orient participants to the subject matter, provide learning objectives, and communicate basic information. These sessions are also used to stimulate critical thinking, through integrated small-group activities, questioning, and discussions.

Demonstration classes are 60-minute engineering classes, each taught by a master teacher, with all ETW participants role-playing as undergraduate students—i.e., taking notes, asking and answering questions, and participating in group exercises. The principal purpose of these demonstrations is to provide models of teaching excellence—to illustrate the application of all ETW concepts, tools, and techniques in the context of typical undergraduate engineering instruction. Through these demonstration classes, participants are also introduced to the processes of assessment and feedback used throughout the ETW.

Labs are hands-on activities in which ETW participants directly apply the concepts, tools, and techniques learned in the seminars and then receive detailed, constructive, individualized feedback on their performance. For all labs, participants are organized into teams of four, and each team is guided by an experienced faculty mentor and one or more assistant mentors. The most important labs in the ETW are three practice classes, which each participant must prepare and deliver to their team members role-playing as students. In forming teams, the workshop coordinators intentionally assign participants from different civil engineering specialty areas, different categories of home institutions, and different cultural backgrounds. Disciplinary diversity creates a more realistic undergraduate classroom environment during practice classes,

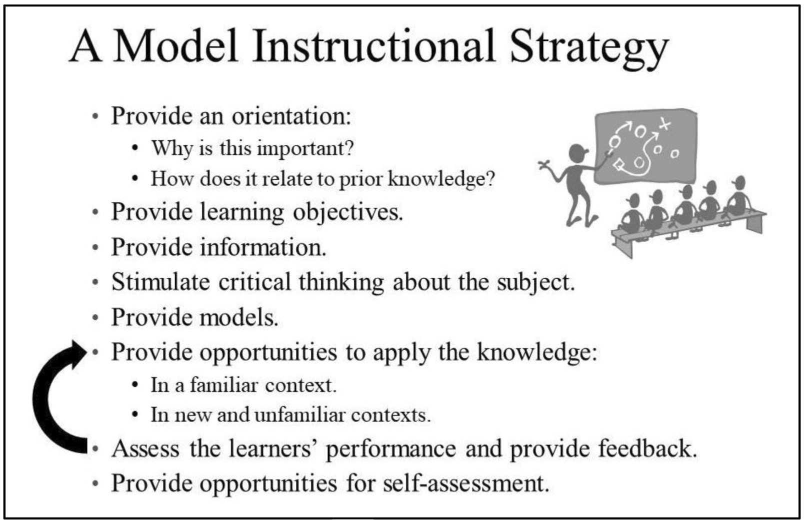

Fig. 3. The ETW Model Instructional Strategy.

because the instructor for a given class typically has a higher level of subject-matter expertise than his or her teammates, who are role-playing as students.

Each practice class addresses an engineering subject of the participant's own choosing, and each is followed by a formal assessment, using a specially formulated ETW Teaching Assessment Worksheet (see Appendix A). The first of these three assessments is performed by the mentor; the second is performed by the participant's peers; and the third is a guided self-assessment. Through this structured progression, participants demonstrate their achievement of the ETW learning objectives, while also developing the self-assessment skills that will be essential for their continued development when they return to their home institutions following the workshop.

The *structure* of the ETW is complemented by *content* that is summarized and communicated to workshop participants via the ExCEEd Model, illustrated in Fig. 4 [30]. This model reflects key research-based principles of effective teaching and student learning, reinforced by the long-term practical experience of veteran ETW faculty leaders. The ExCEEd Model is developed in detail in an early seminar and then referenced in all subsequent ETW seminars and labs. It is directly applied in all assessments of demonstration and practice classes. The model serves as a definition of good teaching, against which participants can assess their effectiveness both at the workshop and after they return to their universities.

Over the past 20 years, the fundamental instructional design of the ETW has been repeatedly validated—first by the ASCE Program Design Workshop, then by each successive cohort of ETW participants and faculty. Given this validation, the overall design of the ETW has remained essentially unchanged since 1999, though the specific workshop content has evolved considerably over this same period.

The inaugural ETW, conducted in 1999, included the following twelve seminars:

- Learning to Teach.
- Principles of Effective Teaching and Learning.
- Teaching Assessment.
- An Introduction to Learning Styles.
- Learning Objectives.
- Planning the Class.
- Classroom Assessment Techniques.
- Communication Skills: Writing and Speaking.
- Communication Skills: Questioning.
- Teaching with Technology.
- Making It Work at Your Institution.
- Developing Interpersonal Rapport with Students.

These seminars were integrated with three demonstration classes and four labs, as illustrated in the 1999 workshop schedule shown in Fig. 5.

Over two decades, in response to systematic evaluation of feedback gathered at each workshop site, the following modifications have been made to the content of the original 1999 ETW:

- The seminar on Teaching with Technology was eliminated to provide additional time for workshop content deemed to be more valuable. To compensate for the elimination of this seminar, demonstrations of effective teaching with technology (e.g., use of clickers, videos, and simulations) were incorporated into several demonstration classes and seminars.
- Similarly, the seminar on Classroom Assessment

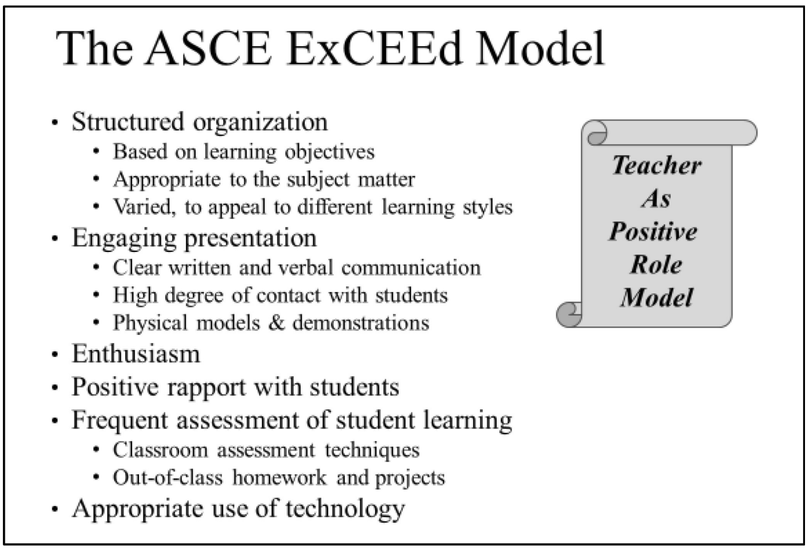

Fig. 4. The ExCEEd Model.

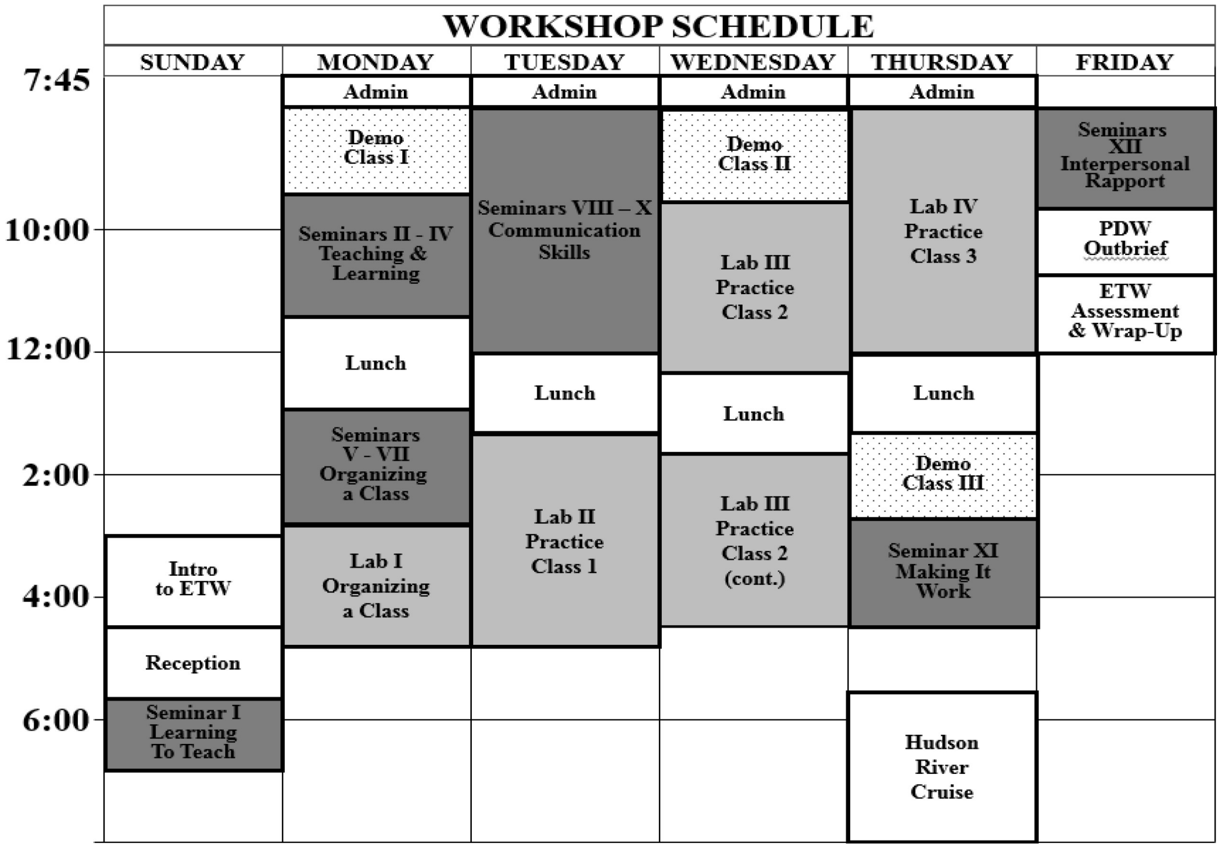

Fig. 5. 1999 ETW Schedule.

Techniques was eliminated, but specific applications of five particularly useful classroom assessment techniques were integrated into other seminars—and were also used to obtain real-time feedback on participants' learning during these seminars.

- New seminars on Systematic Design of Instruction and Nonverbal Communication were added.
- The single seminar on Writing and Speaking was replaced by two seminars, each augmented by substantially enhanced lab exercises.
- The demonstration classes, which originally addressed three distinctly different engineering subjects, were replaced by an integrated package of three consecutive lessons from the same elementary engineering mechanics course. This change allowed for the demonstration of (1) a broader range of instructional techniques, (2) evolution of the instructor's role from a presenter of content to a facilitator of students' active learning, and (3) stimulation of critical thinking at all six cognitive levels of Bloom's taxonomy within a single course.
- A team-building lab was added, and the lab on Organizing a Class was augmented with several new exercises.
- All seminars were periodically refreshed with material from relevant scholarly publications, new small-group activities, and enhanced multimedia content.
- Practice classes started earlier in the schedule, and the seminars were distributed more uniformly across the workshop, rather than concentrating most of them in the first two days. These changes added to the inductive character of the workshop program, added greater variety to the schedule, and caused participants to be more active earlier in the week. It also allowed participants to integrate workshop content into their practice classes in sequential steps—first focusing on organization methods, then on communication skills, then on active learning—rather than all at once.
- Since 2001, the seminar on Making it Work at Your Own Institution has been taught by teams of assistant mentors who are also recent ETW graduates—and thus are able to discuss the relevance of workshop content with a particularly high level of credibility.

The current ETW schedule, which incorporates these changes, is shown in Fig. 6. It is difficult to correlate a specific ETW change to an assessment event because there are multiple sources for change, and ETW instructors have typically been granted

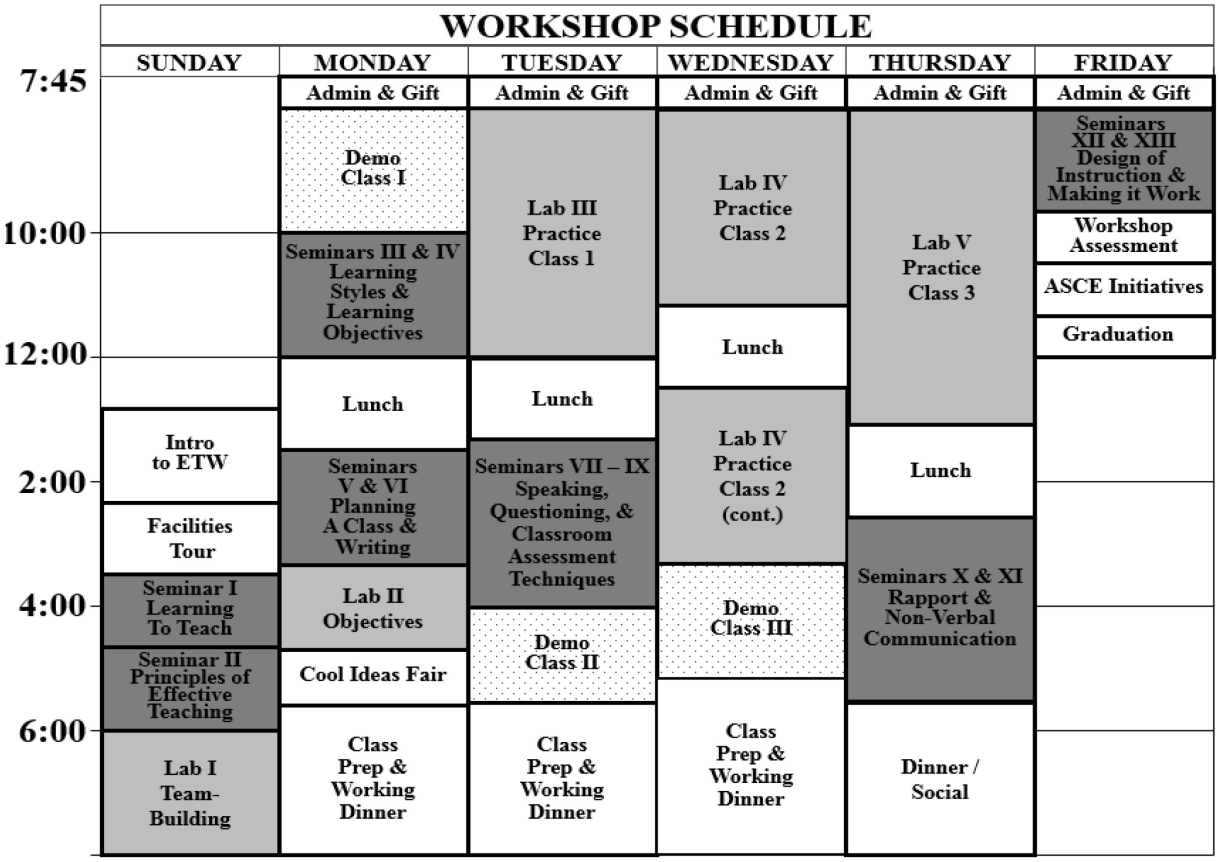

Fig. 6. Current ETW Schedule.

considerable autonomy for trying new things. At the conclusion of every workshop, ETW faculty members conduct a "hot wash," in which the participating faculty list observed strengths, suggested areas for improvement, and recommended changes. The written comments and participant survey ratings also serve as sources for change. The ASCE staff who fund and oversee the workshop have instituted changes, and the CFD often uses their semi-annual meetings to consolidate the findings from various sites, suggest additional changes, and facilitate standardization between sites. As a result, iterative changes tend to coalesce over time—a process that contributes to long-term improvement and collective ownership of the curriculum, but makes the specific source of a given change more difficult to identify.

As this instructional design demonstrates, the ETW fulfills a unique niche in the domain of engineering faculty development programs. Although the ETW program of instruction is generally consistent with the recommendations of Felder, Brent, and Prince [6] (e.g., balance of theory and practice, inductive organization, use of engineers as presenters), it eschews coverage of supplemental topics (e.g., distance education, classroom management, inquiry-based methods) in favor of greater focus on fundamental classroom teaching skills. More importantly, given the requirement for all participants to teach three engineering classes, receive constructive feedback, and incorporate this feedback into their subsequent teaching performance, the ETW offers a uniquely high level of emphasis on *praxis* and teamwork, as proposed by Wlodkowski's model [18].

Over the course of two decades, this instructional program has been sustained and enhanced through a comprehensive system of ETW faculty training and development. Each year, recent high-performing ETW graduates are recruited to serve as assistant mentors. After several years' service, assistant mentors are "promoted" to serve as mentors. Similarly, experienced mentors are called upon to serve as seminar presenters; and acknowledged exemplars are also recruited as instructors for the demonstration classes. Over time, this system has produced a large, enthusiastic cadre of well-trained ETW faculty volunteers who constitute a vibrant community of practice, devoted to furthering the goal of the ExCEEd program–providing participants with the knowledge, skills, and motivation to become effective teachers.

6. A model for the assessment of teaching workshops

According to Van Note Chism and Szabó [31], faculty development programs can be assessed at the following three levels:

- Level 1: Measure participants' satisfaction with the program.
- Level 2: Measure the impact of the program on the participants' teaching practices and attitudes toward teaching and learning.
- Level 3: Measure the impact of the program on the learning of the participants' students learning.

In assessing the NETI workshop, Felder and Brent observe that Level 3 assessment, though unquestionably most effective, is essentially impossible to implement. "There is no way to retrospectively assess the learning of students taught by hundreds of engineering professors at roughly 200 universities during a 15-year period—and even if it could be done, there would be no way to determine how much of any observed learning gains could be attributed to the workshop [14]." Given that these same conditions are equally applicable to the ETW, we have chosen to focus on Level 1 and 2 assessments in this paper. Moreover, as Felder and Brent have suggested, participants' Level 2 assessments of the extent to which a workshop influenced their teaching practices can reasonably be used as the basis for inferring positive impacts on student learning.

7. Level 1 assessment of the ExCEEd teaching workshop

ETW participants' satisfaction with the workshop is routinely assessed by having all participants and workshop faculty complete a survey at the end of each day's activities throughout the five-day program of instruction. Completion of the survey is emphasized to such a high degree by the ETW faculty that well over 95% of the 963 graduates have completed this survey. Each respondent has the opportunity to provide quantitative feedback on each seminar, demonstration class, and lab, using two Likert style questions–one assessing the *value (How valuable was this event to your development as an educator?)* of the activity on a scale from 1 (low) to 5 (high) and one assessing the *conduct (How well was this event organized and conducted?)* of the activity on a scale from 1 (poor) to 5 (excellent). Respondents also have the option to provide written comments to augment their Likert responses for all activities. In addition to these questions about individual workshop events, the final day's survey also includes summative questions about overall administration and logistics, as well as participants' perceptions of the workshop's overall strengths and areas for improvement. These assessments were initially administered with paper surveys; more recently, they have been implemented through emailed links to online survey tools.

Results of the quantitative portion of these surveys have been collected and averaged over the past

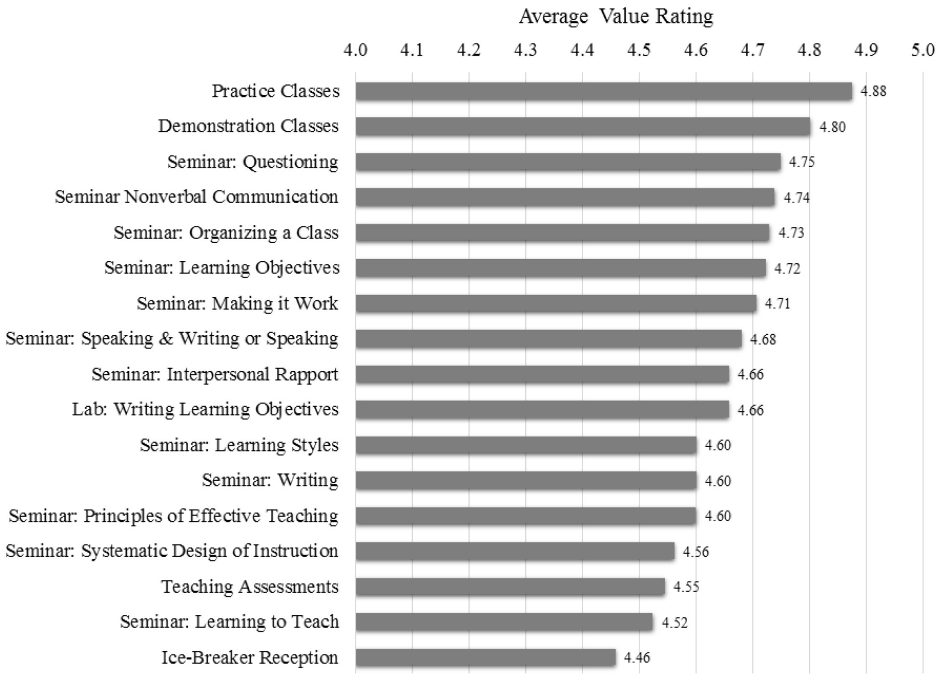

Fig. 7. 20-year average *value* assessments for all principal ETW activities, ranked from high (top) to low (bottom).

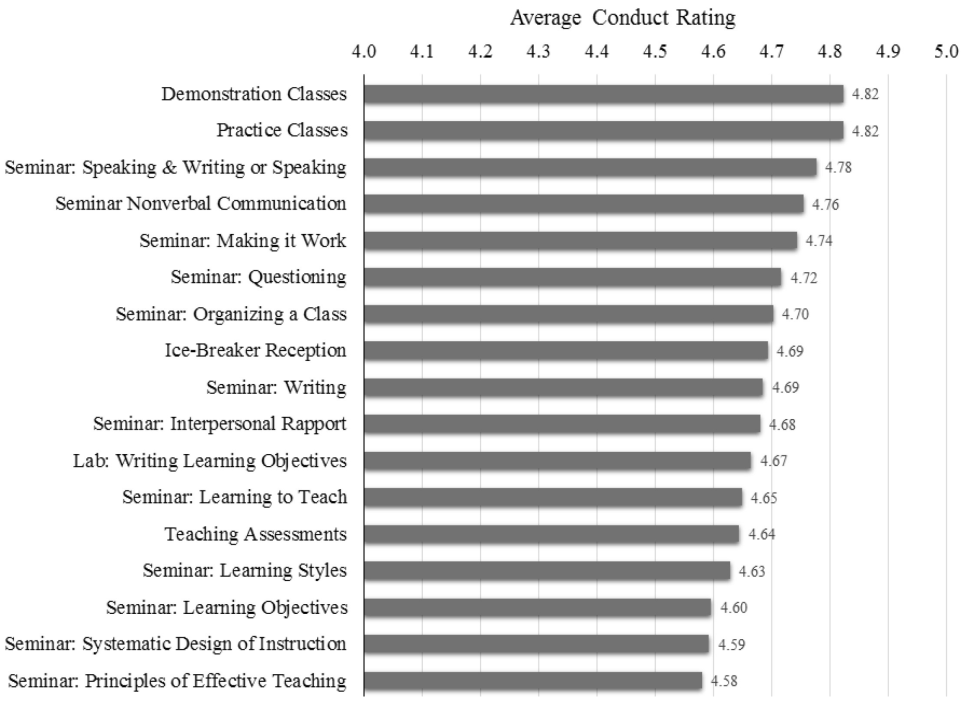

Fig. 8. 20-year average *conduct* assessments for all principal ETW activities, ranked from high (top) to low (bottom).

twenty years. The *value* assessments for all principal workshop activities, ranked from high (top) to low (bottom), are shown in Fig. 7. The two activities that rank the highest are the practice classes and demonstration classes—notably the two most unique components of the ETW program of instruction. Only slightly less valuable were the seminars that provide practical guidance on engaging students (Questioning and Nonverbal Communication), planning instruction (Organizing a Class and Learning Objectives) and applying the ExCEEd Model at participants' home institutions (Making it Work). Collectively, these results constitute a strong validation of the ETW instructional design.

Survey results for the *conduct* of workshop activities are summarized in Fig. 8. As with the *value* results, these 20-year averages are ranked from high (top) to low (bottom). Note that, once again, the

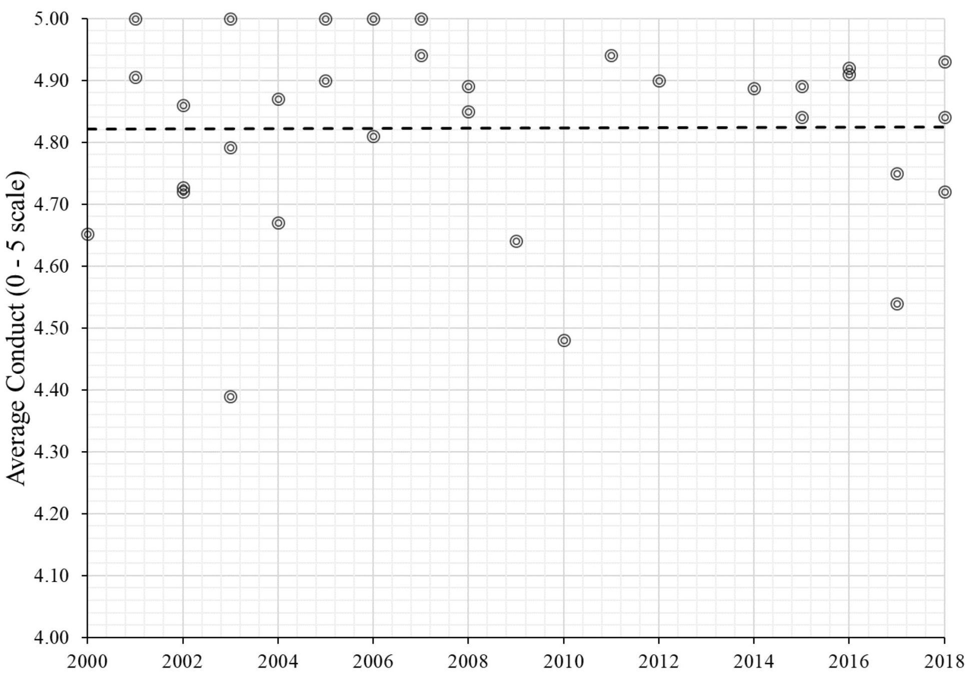

Fig. 9. Individual *conduct* averages (by year) for practice classes.

ETW's two most unique activities—demonstration classes and practice classes—are most highly ranked. Moreover, given that each seminar and demonstration class has been taught by many different workshop faculty over a 20-year period, the consistently high quantitative average (above 4.5 for all workshop activities) demonstrates ASCE's long-term success in recruiting and training well-qualified presenters and mentors for the ETW.

This consistency is further illustrated by Fig. 9, which shows the individual averages (by year) for the *conduct* of the practice classes. The horizontal trend line suggests that, over a period of two decades, a large and diverse group of ETW mentors have been consistently effective in facilitating high-quality learning experiences in this all-important *praxis* component of the workshop.

Individual averages (by year) for the *conduct* of the demonstration classes and one typical seminar (Questioning) are shown in Figs. 10 and 11, respectively. In both cases, the trend lines have a slight negative slope—reflecting a decline on the order of 5% over 20 years. There are two possible explanations for this very small negative trend. First, as noted above, many new instructors and presenters have joined the ETW faculty team over the past decade; and slightly lower conduct assessments typically reflect their first experiences in a new role. Second, as increasing numbers of ETW graduates have returned to their institutions and shared their experiences, subsequent ETW participants have often gained a working familiarity with the ExCEEd instructional model before arriving at the workshop; thus, the "shock and awe" associated with participants' first exposure to the demonstration classes and seminars has decreased somewhat over time. Regardless of its cause, this slight decline in the average conduct assessment of these activities is a small price to pay for the substantial benefits associated with the increases in both the size and diversity of the ETW instructional team.

8. Level 2 assessments of the ExCEEd teaching workshop

Consistent with the model proposed by Van Note Chism and Szabó [31] above, the impact of the ETW on participants' teaching practices and attitudes toward teaching and learning can be measured through the self-reported behaviors and teaching assessments of the participants after they have completed the ETW and returned to their universities. Furthermore, examining the contributions of participants who have subsequently volunteered to serve as ETW faculty can be used to explore the possible influence of additional exposure and reinforcement of the ETW principles. The observations and ratings from the deans and department heads—

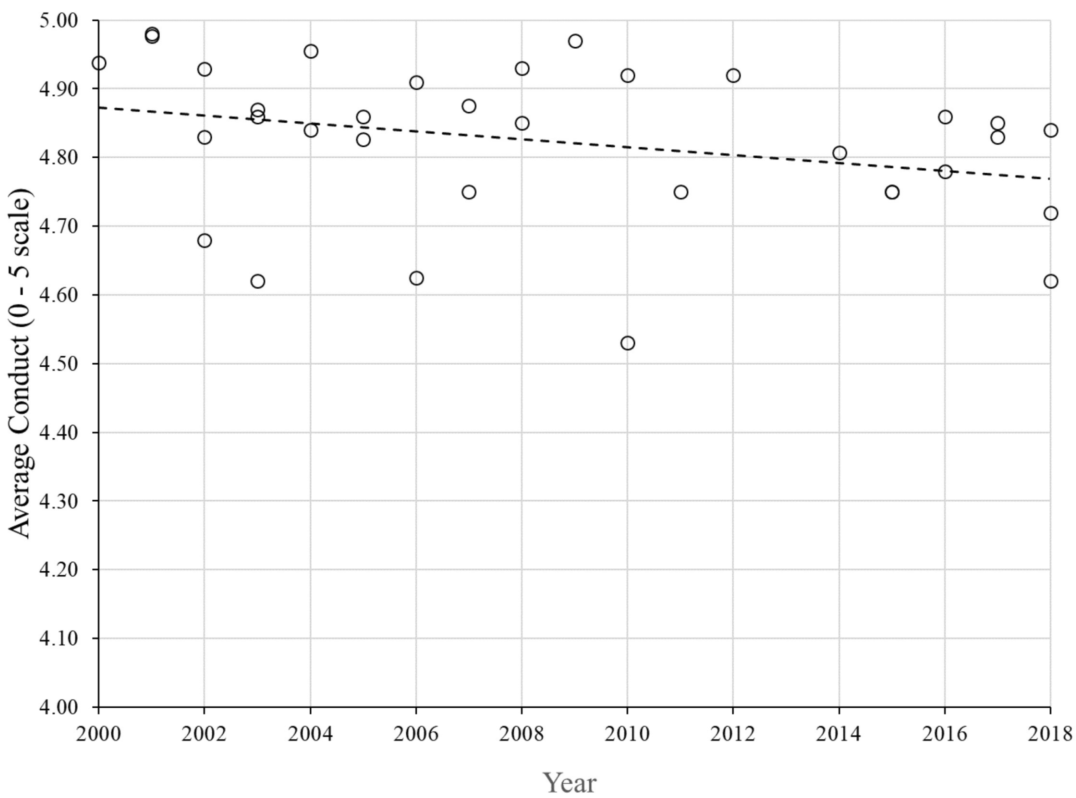

Fig. 10. Individual *conduct* averages (by year) for demonstration classes.

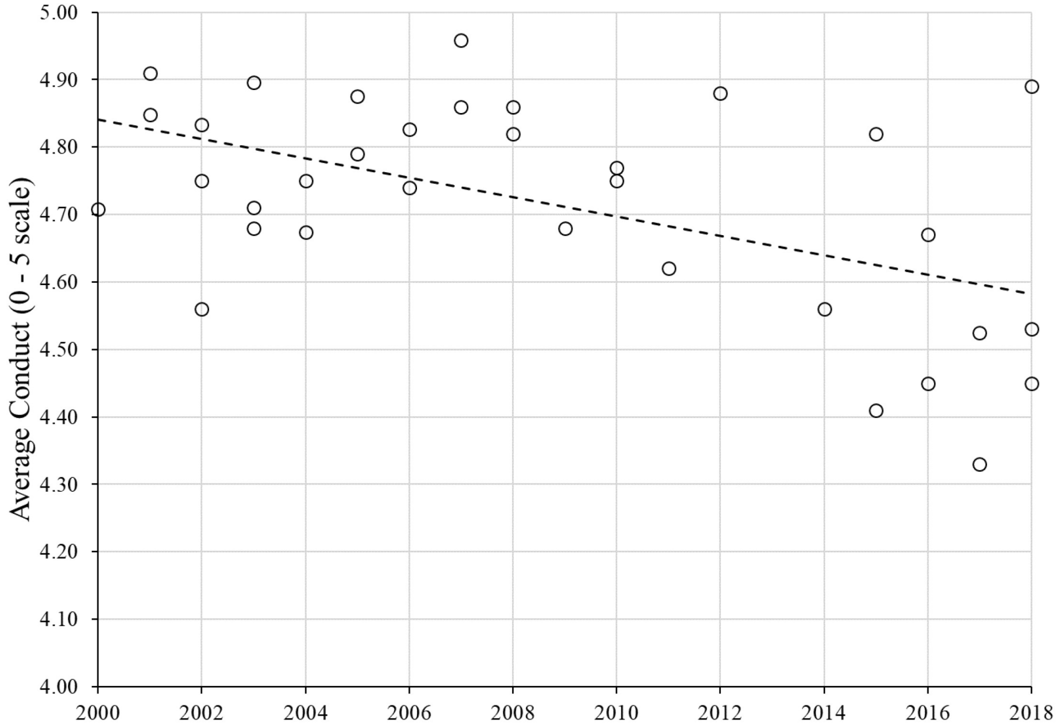

Fig. 11. Individual *conduct* averages (by year) for the seminar on Questioning.

those who hire, supervise and promote faculty members—can provide valuable third-party validation of the participants' self-assessments. And the number of students positively influenced by ETW participants can be used indirectly to quantify the impact of the workshop on the education and development of future engineers.

8.1 Long-term influence on participants

In early 2018, the authors conducted a longitudinal survey of all past ETW participants. After some research, valid e-mail addresses were found for 812 past participants, and 440 responses were received—a 54% response rate. The survey asked 46 questions, addressing such topics as the respondent's year of attendance, current teaching techniques, perceived overall value of the workshop, and subsequent involvement in the scholarship of teaching and learning. To demonstrate the time between the longitudinal survey and actual attendance at the ETW, the distribution of survey respondents based on the year of ETW attendance is shown in Fig. 12. The respondents, on average, attended the ETW 8.3 years prior to this survey. The standard deviation

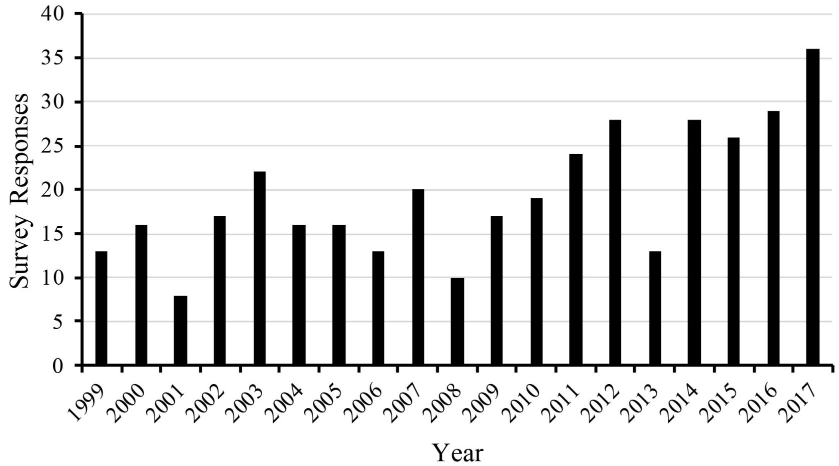

Fig. 12. Distribution of responses to ETW longitudinal survey based on the year of ETW attendance.

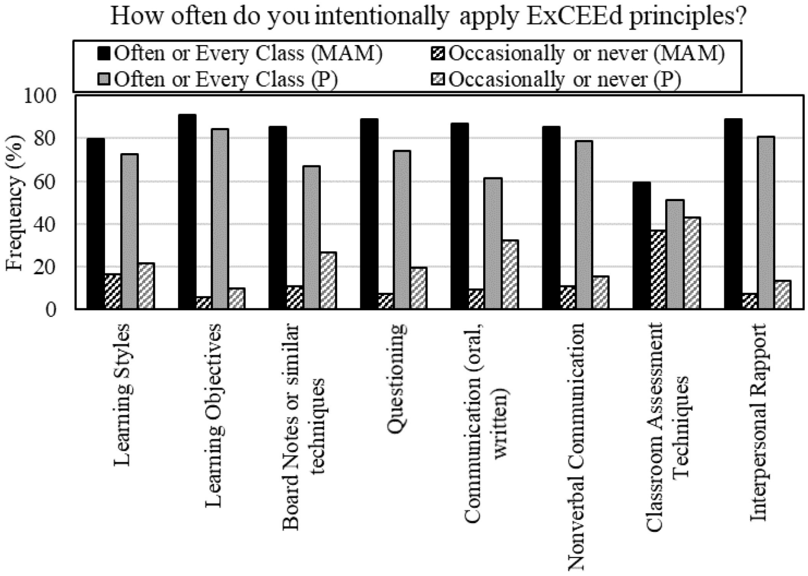

Fig 13. Frequency with which ETW participants (P) and ETW mentors and assistant mentors (MAM) apply ExCEEd principles in their teaching.

was 5.5 years indicating a wide distribution of times since attending the ETW. In addition, 95% of respondents reported that they were still employed as faculty members—a result suggesting that the ETW has been successful in attracting participants with the potential for long-term success in higher education.

Fig. 13 shows key teaching principles promoted in the ETW and the frequency with which past participants have incorporated them into their teaching. The top two principles are the use of learning objectives and the development of interpersonal rapport with students. 84% and 81% of respondents, respectively, implement these techniques often or in every class. Classroom assessment techniques are used least frequently but are still used either often or in every class by over half of the respondents.

In response to other questions:

- 70% of respondents stated that their teaching evaluations improved after attending the ETW.
- 82% rated the ETW as either important or essential to their growth as a teacher.
- 75% stated that the ETW was either important or essential to changing their perception or understanding of engineering education.
- For those respondents who have been considered for tenure since attending the ETW, 83% stated that the ETW helped them gain tenure.
- 90% of respondents would favorably recommend and 80% would "absolutely" recommend the ETW to a new faculty member in their department.

The ETW experience has inspired many participants to engage in scholarly work in engineering education. Fig. 14 shows the percentage of ETW participants who have produced conference papers, journal articles, and books or have attained grants and completed projects as a result of attending the ExCEEd Teaching Workshop. In addition, approximately 18% (59 respondents) reported winning teaching awards at the national, university, regional, college, or student levels. The longitudinal survey responses indicate that the ETW has made a substantial impact on the participants' teaching practices and has positively affected their attitudes toward teaching and learning.

8.2 Long-term influence on workshop faculty

One reason that the ETW has required such a substantial financial investment by ASCE is that, by design, its student-to-faculty ratio is less than 2:1. This commitment of human resources is essential for the conduct of small-group exercises, laboratories, and personalized performance assessments. As a result, over the past two decades, 200 individuals have served as workshop faculty, in the roles of site coordinator, mentor, assistant mentor, seminar presenter, and demonstration class instructor. Among these ETW faculty members, 123 were faculty at the United States Military Academy (USMA) or had gone through training at the in-house summer instructional development workshop held at USMA, but had not attended the ETW. Because the present study is focused on quantifying the short— and long-term effects of *participation* in the ETW, the longitudinal survey was administered only to the 77 workshop faculty who had actually completed the ETW as participants. Fifty-four responses were received from these

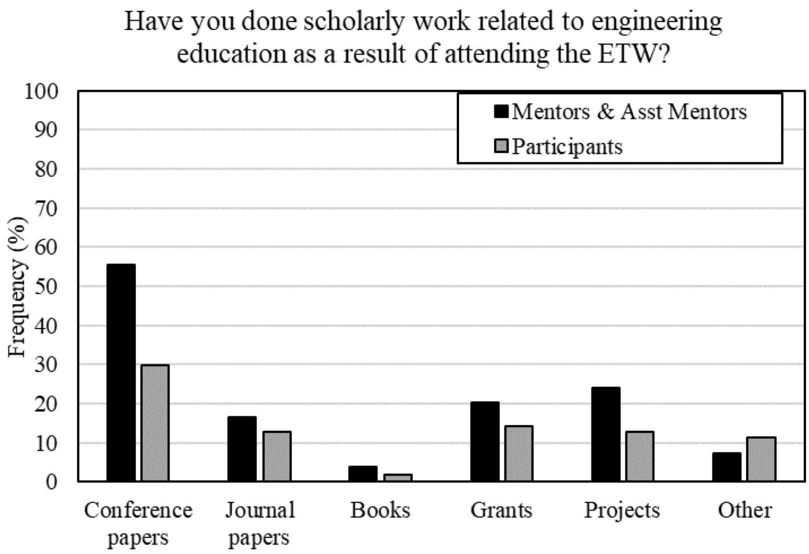

Fig 14. Frequency with which ETW participants, mentors, and assistant mentors have completed scholarly work as a result of the workshop. The survey required a yes or no response.

mentors and assistant mentors (MAM), yielding a 70% response rate.

In response to this survey, MAMs reported incorporating *all* key ETW teaching principles more frequently than other ETW participants, as shown in Fig. 13. MAMs also reported greater improvements in teaching evaluations, and they considered the ETW more important to their professional growth.

Fig. 15 shows that MAMs are more engaged in leadership roles than are participants who have not served as MAMS. For example, 25% of MAMs have served as Department or Program Chair and 25% as Graduate or Undergraduate Coordinator. Almost 40% of MAMs have authored an ABET self-study report or led their program's accreditation effort, and 10% serve as ABET Program Evaluators. 30% have been a chair of a university- or college-level committee. In comparison with other ETW participants, MAMs have done more scholarly work related to engineering education, collaborated more often with other faculty, received more teaching awards, and taken on more leadership positions. MAMs also reported that continued

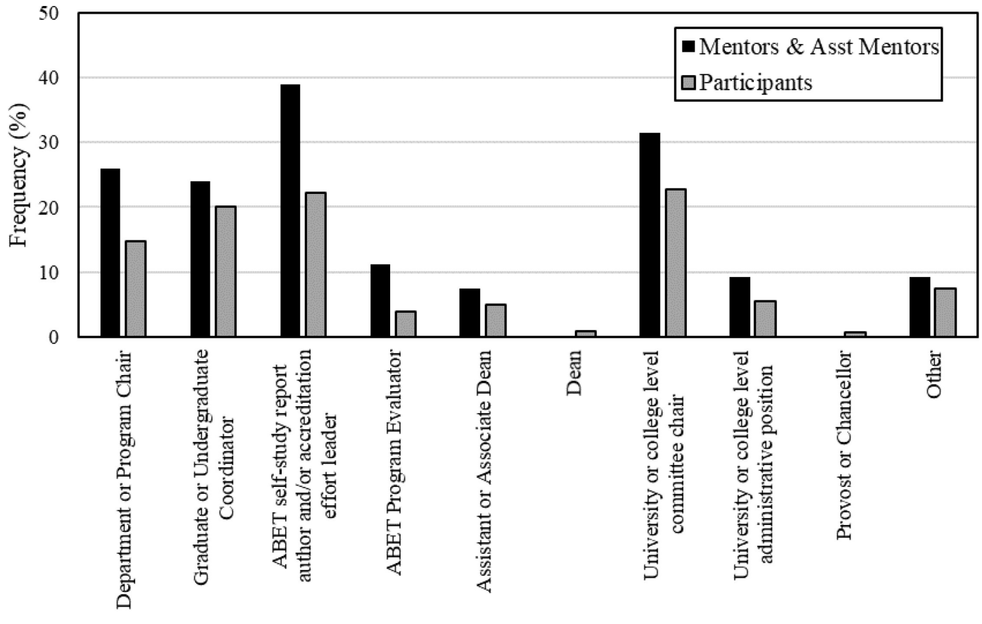

Fig. 15. Frequency with which ETW mentors and assistant mentors have assumed leadership and service positions at their institutions. The survey required a yes or no response for each position.

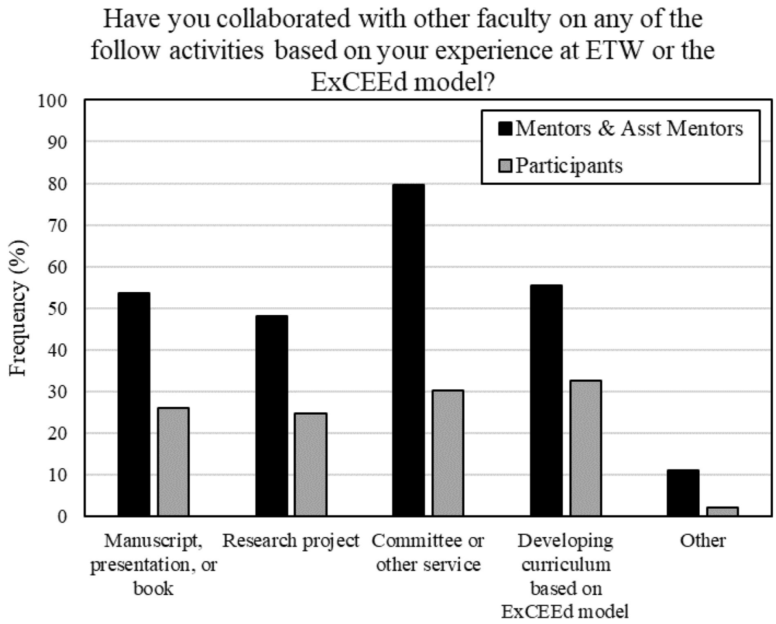

Fig 16. Frequency with which ETW mentors and assistant mentor have collaborated with other faculty in scholarship, service, and curriculum development. The survey required a yes or no response.

involvement in the ETW supported their professional and academic development.

In short, these results demonstrate that service as an ETW faculty member is strongly correlated with a wide range of positive behaviors, achievements, and attitudes–adoption of research-based teaching practices; improved student ratings; teaching awards; engagement in educational scholarship, professional service, and leadership; and commitment to instructional development. There are two possible *causes* of this correlation:

- Hypothesis #1—Workshop graduates gain greater benefits and internalize key concepts to a greater degree by serving subsequently as MAMs. Logically, these benefits would derive from repeated exposure to the ETW course materials, additional reflection, opportunities to teach key concepts to others, and opportunities to assess others' teaching performance.
- Hypothesis #2—Highly capable workshop graduates (i.e., those who have strong teaching skills, strong leadership skills, and strong commitment to instructional development, scholarship, and service) are more likely to volunteer and be selected as MAMs than other ETW graduates.

The available data do not provide an adequate basis for conclusively proving or disproving either of these hypotheses; indeed, it is quite possible that *both* are contributing to the correlations described above. Regardless, both of these possible causes represent highly positive outcomes for the ExCEEd program.

Beyond these survey results, it is also clear that broad participation in the ETW faculty has created a community of practice, devoted to collaborative contributions toward excellence in civil engineering education. As shown in Fig. 16, approximately 50% of MAMs and 25% of other participants have collaborated with others on scholarly work, while 80% of MAMs and 30% of other participants have engaged in related committee work or other service activities because of the ETW.

8.3 Assessment by department heads and deans

As discussed above, Level 3 assessment (impact on student learning) of the ETW is infeasible; however, it is possible to extend and enrich the Level 2 assessment (impact on participants) by querying the deans and department heads[1] who have supported and funded their faculty members' attendance at the ETW. These leaders can provide an independent validation of their ETW-trained subordinates' gains in teaching performance, and they can attest to the broader value of the ETW through their continued support of the program.

In the spring of 2018, the authors conducted a survey of civil engineering (CE) department heads from 234 U.S. schools that have CE programs. This accounts for 81% of the accredited civil and architectural engineering programs in the U.S.

[1] In this paper, we use the term *department head* to represent anyone with direct authority over the management of a civil engineering program. This includes individuals with the title *department head, department chair, program director*, or *program coordinator*.

Responses were received from 116 of these surveyed leaders–a 49.6% response rate. These programs produce over 11,500 civil engineering graduates per year and employ more than 2,400 full time equivalent faculty members, as reported by the survey respondents.

In the survey, the CE department heads were asked to rate the quality of the teaching, service, and scholarship of their ETW graduates, compared to faculty who had not participated in the ETW. In each category, they were asked if their faculty who had graduated from the ETW were clearly superior, above average, no different, below average, or clearly not as good as those who have not attended the ETW. They could also choose "no way to judge" as a response. The survey respondents rated the quality of their ETW graduates' teaching as clearly superior (28%) or above average (58%), in comparison with non-ETW graduates in their departments; none were judged as below average or clearly not as good, as shown in Fig. 17. As further confirmation of these positive workshop outcomes, 61% of survey respondents said their ETW graduates had received teaching awards, and 58% said they receive awards at a higher rate than their peers.

Since improving the quality of teaching is the principal goal of the ETW, these higher ratings might have been expected. But surprisingly, as indicated in Table 3, ETW graduates are also rated more highly in terms of their service and scholarship, as compared with peers who are not ETW graduates—though to a lesser degree than in the domain of teaching. The survey results also indicated that ETW graduates are more likely to accept leadership positions in their departments or colleges and are more likely to interact with students outside the classroom, particularly as student club advisors.

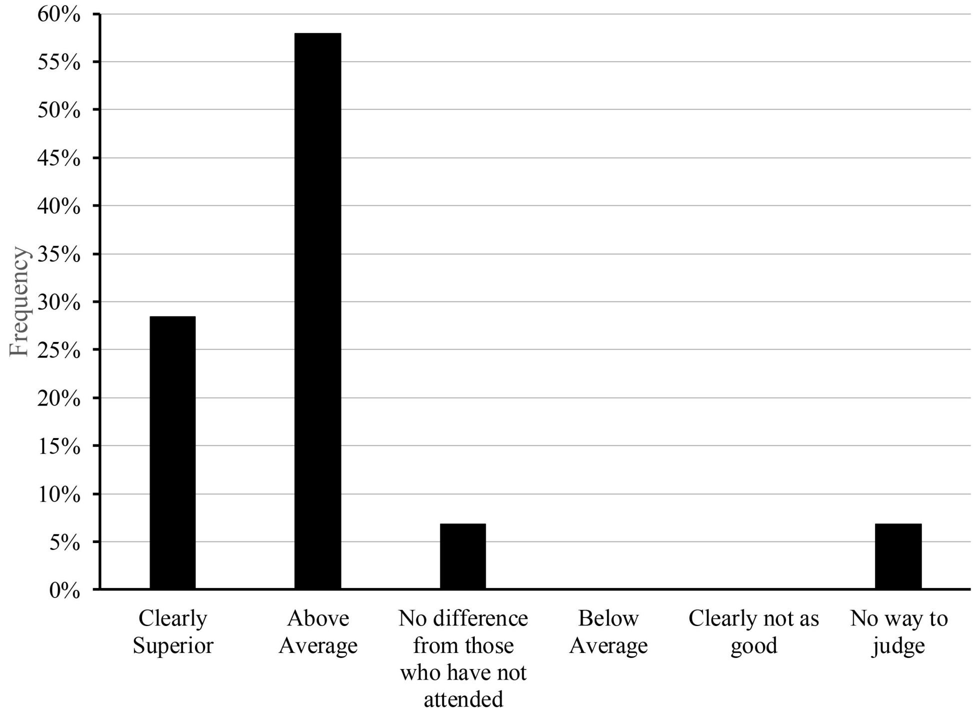

Fig. 17. Civil engineering department heads' assessment of ETW graduates' quality of teaching, in comparison with faculty who have not attended ETW.

Table 3. Civil engineering department heads' assessment of ETW graduates' quality of teaching, scholarship, and service, in comparison with faculty who have not attended ETW

Quality of Graduates of ETW	Clearly Superior	Above Average	No difference	Below Average	Clearly not as good	No way to judge
Comparing the quality of Teaching between ETW grads and non-grads	28.4%	58.0%	6.8%	0.0%	0.0%	6.8%
Comparing the quality of Scholarship between ETW grads and non-grads	8.0%	30.7%	46.6%	4.5%	0.0%	10.2%
Comparing the quality of Service between ETW grads and non-grads	11.4%	36.4%	37.5%	2.3%	0.0%	1.5%

A common perception is that the ETW is more valuable to predominantly undergraduate schools, where teaching is emphasized, than to Ph.D.-granting universities, where research is more highly valued. Although 71% of the survey respondents were from research institutions, there was no significant difference between the department chairs' responses from these two categories of universities, regarding either their assessments of ETW graduates' performance or their willingness to support the ETW program. 79% of survey respondents reported that they actively encourage their faculty to attend the ETW; and, more importantly, 81% indicated that they fully fund ETW participation. (An additional 9.2% fund it in part.) Both the encouragement to attend and the willingness to provide financial support apply equally to research and predominantly teaching universities, as shown in Fig. 18. This level of support is further demonstrated by the increasingly large number of ETW applications received each year from both types of universities.

A similar survey was administered to deans of engineering schools and colleges. Sixty-two of the 82 deans attending the 2018 Engineering Deans Institute completed the survey, which was focused on teaching workshops, with an emphasis on the ETW. In general, most of the deans were supportive of teaching workshops, offered financial support, and encouraged faculty to attend. Support for the ETW and the perceived quality of ETW graduates increased considerably if the dean had a CE program as part of his or her college, had a terminal degree in CE, or knew of an ETW graduate within the college. Those deans with a CE background most likely served previously as CE department heads and were knowledgeable about ASCE activities; thus, they provided responses that were consistent with the surveyed CE department heads. The largest proportion (21%) of the deans in this survey had civil engineering as their terminal degree. The next largest numbers of terminal degrees were mechanical (15%), electrical (11%) and chemical (10%) engineering. Roughly 60% of the deans surveyed were from research institutions.

Only 25 (40%) of the deans (10 with CE terminal degrees and 15 without) responded that they knew of an ETW graduate in their college. Although this sample size is small, the results are still compelling. As Fig. 19 shows, 90% of the 10 deans with CE degrees and 67% of the 15 deans with terminal degrees in other disciplines rated the ETW graduates as clearly superior or above average in teaching, when compared to non-ETW graduates.

The most interesting finding in this survey is the highly positive response received from deans who did not have a CE terminal degree but had an ETW graduate within the college. Apparently, in these cases, the success of the ETW in the college's CE program was sufficient to catch the attention of non-CE deans who had no previous exposure to this workshop. The deans are important constituents and have been instrumental to the success of the ETW. Although they are further removed from the ETW than department heads, the Deans' responses add an additional perspective, and confirm feedback presented by other sources.

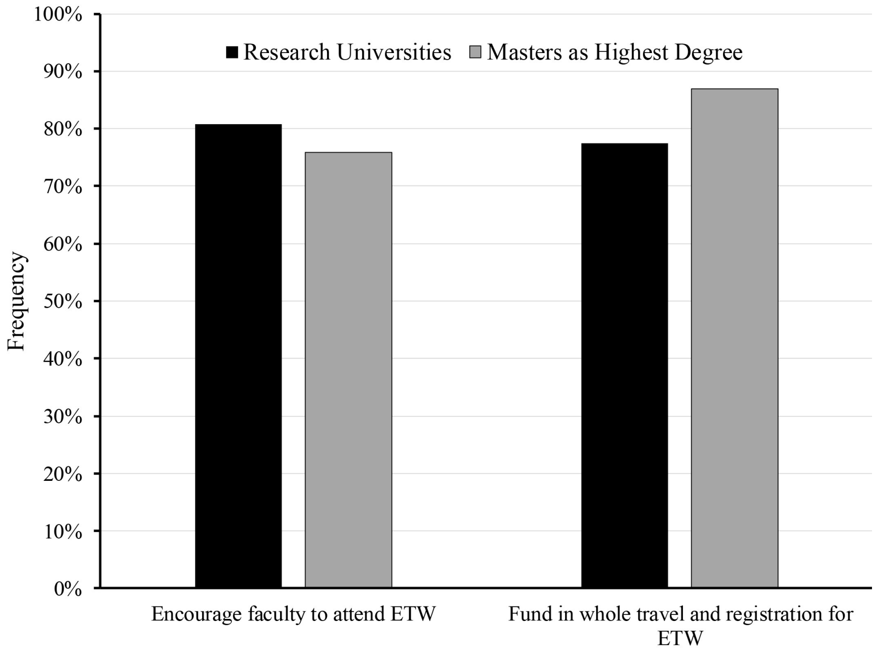

Fig. 18: Support of CE department heads for faculty participation in ETW, by category of university.

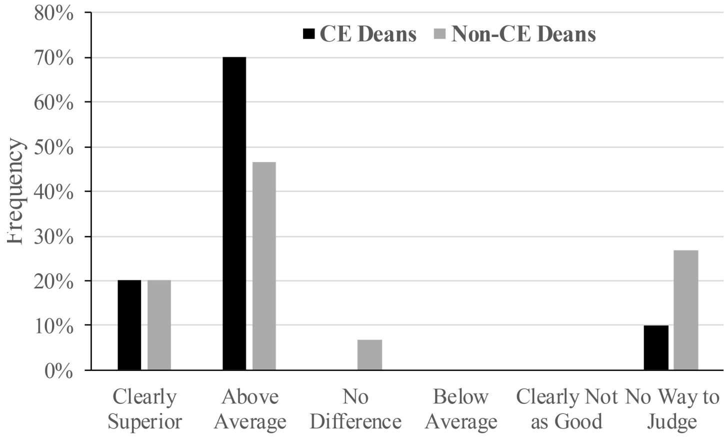

Fig. 19. Engineering deans' assessment of ETW graduates' quality of teaching, in comparison with faculty who have not attended ETW.

Overall, survey responses from the deans and department heads confirm the feedback provided by ETW participants and MAMs—that the ETW has had a substantial positive influence on teaching practices and faculty performance in U.S. civil engineering programs.

8.4 Influence on scholarship in teaching and learning

The ETW has influenced civil engineering education even more broadly through the systematic dissemination of workshop principles and practices via scholarly publications written by members of the ever-growing ExCEEd community. A series of quarterly scholarly articles [7, 26, 32–36] were published in the *ASCE Journal of Professional Issues in Engineering Education and Practice* to document and disseminate the central concepts and techniques of the workshop. In a wide variety of publications, ETW graduates have attributed teaching awards, attainment of tenure, improved student ratings, better class preparation, increased satisfaction with teaching, and enhanced student learning to their participation in the workshop. Welch et al. [37], Devine [38], Knapp [39], Isaacs [40] and Durham and Marshall [41] provide several such examples.

The effectiveness of the ETW was formally assessed in the first few years after its implementation [42, 43] and more formally at the ten-year anniversary [44, 45]. The findings from surveys and assessments completed at the ten-year anniversary are highly consistent with the results reported in this paper, indicating long-term consistency in ETW implementation. The impact of the ETW has also been documented through reporting and extension of its key principles [46–48]. Other research has used the ETW principles as a basis for developing new teaching workshops [49, 50], evaluating teaching [51, 52], and supporting mentorship, recruitment, and development of new faculty [53–55]. The ETW model has also been applied to instructional development programs for adjunct faculty [56] and teaching assistants [57–59].

Geiger and O'Neill [60] used the ETW teaching methodology in a bioengineering curriculum, and Morse [61] applied it to graduate courses in environmental engineering. Hart [62] applied ETW principles to the flipped classroom, while Welch and Farnsworth [63] and Dean and Considine [64] applied them to distance learning. The ExCEEd model served as a cornerstone for developing a civil engineering program at the National Military Academy of Afghanistan from 2007 to 2009 [65-68].

Additional research has expanded upon material from the ETW to create new applications and information repositories for CE educators. Welch and Klosky [69] developed a database of physical models in the classroom. Reese et al. [70] covered the challenges of nonverbal communication in distance learning, and Barry [71] used ETW principles to justify the use of poetry in the engineering classroom. In response to requests for specific examples of teacher classifications in Lowman's Two-Dimensional Model for Effective Teaching [27], Estes and Welch [72] developed a database of teachers portrayed in movies and classified them according to Lowman's Model. In 2018, Farnsworth et al. [73] updated the study and developed more detailed classification techniques. Estes and Lawson [74] developed a freshman design experience as a step-by-step first-hand example of Dick and Carey's methodology for systematic design of instruction [75]. Nilsson, et al. [76] presented examples of using candy and humor to develop positive interpersonal rapport with students. Estes [77] discussed the incorporation of diversity and inclusion into the ETW.

Over the past two decades, the results of these scholarly efforts have, in many instances, been integrated back into the ETW program of instruction as updated seminar content, new technologies, new physical models, and enhanced small-group activities.

Several fundamental concepts in educational theory—such as Bloom's Taxonomy [78] and the use of learning objectives—were largely unknown in the CE education community prior to 1999. Today, largely because of the ETW, these concepts are broadly understood and applied. For example, ETW graduates have been extensively involved in the development and updating of the Civil Engineering Body of Knowledge [79, 80]. As a result, this landmark document uses Bloom's Taxonomy to quantify the achievement of outcomes. Similarly, the ABET civil engineering program criteria [81, 82] use Bloom's Taxonomy to specify appropriate levels of achievement for curricular topics.

A *community of practice* is defined as "a group of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly" [83]. The ETW has created a vibrant community of practice whose research and collaborations have further shared the lessons learned, the applications, and the teaching and learning theory with the broader professional and academic community. As the references cited above suggest, the ASEE Civil Engineering Division has become the most common venue for this community to meet and share knowledge. The ExCEEd model has been further spread by graduates who have shared workshop material with faculty colleagues at their home institutions. Mini-ExCEEd workshops, in which ETW faculty deliver abbreviated workshops at host campuses, have also offered this material to adjunct faculty, graduate students, and faculty in other disciplines who are not eligible to attend the ASCE ETW. This development of a community of practice should not be unique to either civil engineering or the ETW; the process described above—with a rigorous workshop serving as both the entry point and the common ground for a community of practice—is broadly applicable to other disciplines and other types of developmental experiences.

A powerful oral history of the ETW, consisting entirely of anecdotes and reflections from ETW faculty, was recently published by ASCE [84]. Anecdotal comments submitted by ETW participants in conjunction with the longitudinal surveys summarized above are similarly powerful. One such free-form response stated, "ExCEEd is an existential change: it is not just a change in my teaching. It is a change in who I am. It is not merely the most important thing I have done, professionally. It is the most important thing that I have done, period."

8.5 Influence on students

As noted above, Level 3 assessment of the ETW is infeasible. Assessing the impact of the workshop on participants' students' learning would require surveying or directly measuring student learning at over 250 institutions for appropriately selected groups of students taught by ETW graduates, as well as control groups taught by non-ETW graduates. It is quite feasible, however, to estimate the number of students influenced by ETW graduates. Considering *only* the 440 graduates who responded to the survey described above (95% of whom are still teaching), and conservatively assuming that each of these faculty members teaches four courses per year with 30 students per course over a 20 year career, then over one million students will have been positively affected by this workshop. Given the large number of non-respondents, as well as the widespread influence and dissemination of ETW models and principles, as described above, the actual number of affected students is certainly much greater.

9. Conclusions

The influence of the ETW on engineering education over the past 20 years has been both broad and deep. Breadth of impact is reflected in the number of ETW graduates—which is approaching 1000—and the number of institutions that have participated—over 250. Depth of impact is reflected in the life-changing experience reported by so many ETW participants. The ETW has changed the culture in many CE departments—especially those with multiple ETW graduates. This paper has demonstrated through level 1 and level 2 assessment of constituents the relative quality and value of the workshop activities, the degree to which teaching has improved in ETW graduates, the enhanced effect it has had on the ETW faculty, and the high value perceived by those educational administrators who support the workshop. The workshop has also created a vibrant community of practice with a demonstrated commitment to advancing teaching excellence.

These positive influences can be attributed to five critical enablers of success:

- ASCE has been willing to commit substantial resources over an extended period of time to fund the program. The ETW is an expensive and faculty-intensive endeavor. Even today, with a registration fee of $1000, ASCE funding provides each participant with a *de facto* fellowship worth $1500.
- The ETW is based on a consistent, coherent learn-

by-doing instructional model that is well grounded in teaching and learning theory.
- The 20-year project has been sustained by strong leadership and high-quality implementation, as evidenced by participant assessments over that entire time period
- ASCE has facilitated the long-term, systematic integration of high-performing ETW graduates back into the ETW faculty team. This ever-growing pool of ETW instructors, mentors, and assistant mentors has contributed to the enhancement of CE education in myriad ways, both within the workshop and beyond.
- Seven different host institutions and their local champions have been willing to perform the substantial administrative and logistical functions associated with organizing, housing, feeding, transporting, and providing facilities for 24 participants and 12 ETW faculty members for each week-long workshop.

The ETW has made a unique contribution to engineering instructional development through its research-based design, its active learning format, and its sustained record of success throughout 41 workshops over a 20-year period. The extent to which the ETW has influenced teaching practices in U.S. civil engineering programs is reflected in the number of participants, their extensive and well-documented application of workshop principles in their teaching, the enhanced contributions made by ETW faculty, the financial and moral support from deans and department heads, and the sheer number of students whose educational experiences have ultimately been affected by this workshop.

The ETW responds to various studies [4, 5, 7–9] that show students are leaving the SME disciplines largely due to poor teaching and reveal that most SME faculty never receive any formal training in effective classroom teaching. This paper reports a two-decade solution implemented by the U.S. civil engineering community. The methodology, implementation, and results are equally applicable to other SME disciplines (physics, chemistry, mechanical engineering, electrical engineering, etc.) and in other countries that teach SME subjects at the university level. This wider audience would certainly benefit from a teaching workshop that covers the relevant teaching and learning theory, translates these theories into practical applications, provides demonstrations of good teaching, and most importantly has participants teach actual classes and receive detailed and mentored feedback. Other SME disciplines can also attain the long-term cumulative advantages of sustaining a workshop for 20 years.

10. Challenges for the future

While the ETW has been highly successful for two decades, it will take continued effort to keep it successful for the next 20 years. There are a number of identifiable challenges that will need to be addressed:

- As the ETW has matured and its benefits have gained wider acceptance, the cost of the workshop has been increasingly passed onto those who personally benefit from it. This trend is likely to continue, as ASCE cannot be expected to continue its current funding level indefinitely. Future budget shortfalls might be addressed by finding external donors who will support the program philanthropically, by more schools following the lead of the University of Nebraska and sponsoring a workshop, or by developing a revised funding model, in which the registration fee is increased further, but with a scholarship provision for participants from universities that cannot afford the increased cost.
- As the value of the ETW has been increasingly recognized, the number and quality of participant applications has increased. The demand for ETW participation will likely increase further, as university faculty members retire and new faculty are hired, and as adjuncts and faculty from other engineering disciplines seek similar instructional development opportunities. New venues will be needed to meet this increased demand. Additional one-week workshops might not be the answer; rather, creative use of distance learning, mini-ExCEEd workshops, larger workshops, and portable learning materials might be more feasible. The challenge will be maintaining the current level and quality of mentored experience in such alternative venues.
- If the ETW is to remain viable and valuable, it will need to respond to major paradigm changes in engineering education and new findings in the scholarship of teaching and learning. These changes include, but are not limited to, larger class sizes, new technologies, an increased reliance on distance learning, increased use of teaching assistants and adjuncts, and a greater emphasis on diversity and inclusion. Undoubtedly, there will be more changes in the next 20 years that we do not currently foresee. The ASCE CFD has taken a proactive approach by updating the ETW seminars to reflect the current state of educational knowledge and practice. Long-standing ETW content and concepts that are currently under review include the validity of learning styles, the formulation of Bloom's taxonomy, the validity of student ratings, studies on

why students leave engineering, [7, 85] classification of student types [27], and the use of tablet computers in the classroom. The results of these reviews will ensure that the ETW continues to reflect current best practices.

- As the body of teaching and learning knowledge grows and the size of the ETW graduate population increases, so does the need for an advanced-level workshop to address additional topics. ASCE has already run two ExCEEd II workshops in 2009 and 2012 [86]; however, a more sustainable funding model is needed to support these advanced instructional development experiences.

None of these challenges are insurmountable, especially if the same level of passion and commitment can be found among those who see the value and the need for high-quality teaching workshops.

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Appendix A. Teaching Assessment Worksheet used in ETW

TEACHING ASSESSMENT WORKSHEET

INSTRUCTOR:________________ **ASSESSED BY:**________________

LESSON TOPIC:________________________ **DATE:**________

STRENGTHS:

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AREAS FOR IMPROVEMENT:

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	Needs Work	Good	Excellent	Remarks
TECHNICAL EXPERTISE				
Command of the Subject Matter				
LESSON ORGANIZATION				
Lesson Objectives				
Organization of Boards & Classroom Activities				
CONDUCT OF THE CLASS				
Enthusiasm, Energy, and Confidence				
Orientation to the Subject Matter				
Clarity of Presentation *(boards, viewgraphs, etc.)*				
Clarity & Precision of Explanations				
Voice *(volume, speed, variation)*				
Questioning & Answering Questions				
Contact with Students				
Visual Aids and Demonstrations				
Time Management				
Appropriate Use of Textbook				
THE CLASSROOM ENVIRONMENT				
Classroom Appearance				

OVERALL ASSESSMENT:
Are the students who attended this class adequately prepared to accomplish the Lesson Objectives? ☐ **No** ☐ **Not sure** ☐ **Yes**

Specific areas on which to focus during your next class:

1.____

2.____

3.____