Beyond the Textbook: Insights from the ASCE mini-ExCEEd Teaching Workshop on Fostering Teaching Excellence Across Two- and Four-Year Institutions

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The teaching effectiveness of instructors significantly influences the learning experience of engineering students, especially in critical lower division "gatekeeper" courses such as Statics and Mechanics of Materials. These courses are characterized by high DFW (D grade, F grade, or withdrawal) rates, which can substantially delay student progress. Multiple factors can contribute to student difficulties in rigorous lower-division courses. These include the quality of students' pre-college STEM classes, removing structural barriers to learning for working students, and limited formal pedagogical training for the instructors. This paper will address the instructors' aspects of these challenges. To address the urgent need for instructor support, a National Science Foundation (NSF)-supported, two-day mini-ExCEEd Teaching Workshop was held in partnership with the American Society of Civil Engineers (ASCE). This condensed workshop was designed to provide essential teaching pedagogy skills to a diverse group of 32 faculty. Participants were from two-year institutions (41%) and four-year institutions (59%). Attendees included full-time faculty (59%) and adjunct faculty (41%). This paper details the structure and core content of the mini-ExCEEd workshop. It also analyzes participant feedback, revealing key insights into the pedagogical needs of adjunct faculty and educators from two-year institutions. The responses indicated that many instructors had not had previous access to teaching workshops. The instructors viewed the mini-ExCEEd experience as a transformative opportunity to re-evaluate their instructional design from a student-centric perspective. The findings strongly suggest that developing and offering more accessible, targeted teaching workshops is crucial for enhancing the quality of engineering education across all institutional types.

01. Introduction

This evidence-based practice paper describes the design, implementation, and assessment of a condensed faculty development workshop targeting pedagogical knowledge and instructional technique adoption. There was a particular emphasis on serving non-tenure-track (NTT) and community and technical college (CTC) faculty who face systemic barriers to professional development access (Lord & Camacho, 2007). To provide a common context for participation, the team focused on helping faculty in the Science, Technology, Engineering, and Mathematics (STEM) fields, teaching lower-division gatekeeper courses that often have high DFW (D grade, F grade, Withdrawal) rates at both CTC and 4-year institutions. While research has established that effective teaching in these courses requires explicit instructional design, active learning integration, and attention to diverse student needs (Adams & Felder, 2008; Sohoni & Craig, 2016), opportunities for engineering faculty to develop such pedagogical expertise remain fragmented and inequitably distributed. Traditional week-long workshops and semester-long programs, while valuable, exclude instructors who lack institutional support, flexible schedules, or adequate compensation for professional development participation (Chen et al., 2024; Mejia et al., 2024).

This paper addresses a critical question for the Faculty Development Division: Can a condensed, accessible workshop effectively improve pedagogical knowledge and instructional practice adoption among diverse engineering educators, including those systematically excluded from traditional professional development? American Society of Civil Engineers (ASCE)'s Mini ExCEEd (Excellence in Civil Engineering Education) Teaching Workshop at Cal Poly Pomona was a two-day intervention that served two purposes: (1) to deliver evidence-based pedagogical content and (2) to accommodate the constraints facing NTT and CTC faculty to attend this workshop. The workshop effectiveness was measured through pre-post knowledge gains across seven instructional topics and examined participants' planned implementation of learned techniques. The findings demonstrate that short, focused workshops can produce meaningful pedagogical knowledge improvement and high implementation intent when designed with accessibility, compensation, and community-building as core principles.

02. Literature Review

Engineering educators in introductory courses face a pedagogical paradox: these courses require the most sophisticated teaching to serve diverse student populations and maintain high standards, yet the instructors teaching them often receive the least pedagogical preparation. Lower-division courses typically serve students with varying levels of prior preparation, first-generation college students, students balancing work and family responsibilities, and students from groups underrepresented in engineering (Lord & Camacho, 2007). Many engineering faculty, trained as researchers and practitioners rather than educators, lack formal preparation in learning theory, instructional design, or evidence-based teaching methods (Stice et al., 2000). When instructors default to transmission-oriented teaching focused on content coverage rather than student sense-making, they inadvertently create "gatekeeper" courses that filter students based on prior preparation rather than engineering potential (Sohoni & Craig, 2016). Faculty development thus serves not merely as skill enhancement for individual instructors but as a fundamental equity intervention that can reshape who succeeds in engineering pathways.

Engineering education has developed multiple models for supporting pedagogical development, each with distinct strengths and accessibility challenges. Professional development opportunities include multi-day workshops (such as the National Effective Teaching Institute), semester-long learning communities, teaching certification programs, mentoring relationships, and departmental teaching groups (Felder et al., 2011). These intensive formats can foster deep engagement with learning theory, sustained practice with feedback, and transformative shifts in teaching philosophy (Fink et al., 2005). However, the predominant format remains short-term, single-institution workshops lasting one to five days (Chen et al., 2024). More critically, systemic barriers limit who can access even these abbreviated interventions. Tenure systems that prioritize research over teaching provide neither time nor incentive for pedagogical skill development. Financial barriers—conference registration, travel costs, lost teaching income—exclude instructors without institutional support (Chen et al., 2024).

These structural inequities create a faculty development system that serves those who need it least (tenure-track faculty with departmental support) while excluding those who need it most (NTT and CTC faculty teaching the majority of introductory students). The systematic exclusion of NTT and CTC faculty from engineering education professional development represents a fundamental misalignment between who teaches lower-division courses and who benefits from pedagogical training. These instructors constitute an emerging majority of the introductory engineering teaching workforce yet face compounding barriers that traditional professional development structures fail to address. Beyond logistics, NTT and CTC faculty report feeling unwelcome in professional development spaces designed for tenure-track faculty, where conversations center on research integration, graduate student mentoring, and departmental politics rather than the realities of teaching-focused positions (Strong et al., 2019). Despite an emerging understanding of design principles for accessible faculty development, significant gaps remain in practice.

03. Teaching Workshop

To respond to professional development needs for this workforce, a teaching workshop was created with the needs of NTT, and CTC faculty in mind. A two full-day workshop was proposed with $1200 compensation (to accommodate for NTT faculty members who may hold full-time industry positions), a two-day hotel reimbursement, and the workshop was held over the summer when faculty are generally on a break. Furthermore, American Society of Civil Engineers (ASCE) ExCEEd (Excellence in Civil Engineering Education) Teaching Workshop was utilized, as they have 27 years of experience in training faculty members. For the first two decades of its existence, 38 ExCEEd Teaching Workshops (ETW) have been held at the United States Military Academy West Point, the University of Nebraska, Lincoln, the University of Arkansas, Northern Arizona University, University of Texas at Tyler, University of Colorado, and Florida Gulf Coast University. The program has 912 graduates from over 252 different U.S. and international colleges and universities (Estes et al, 2018). While ASCE's ExCEEd Teaching Workshop is generally five days, a two-day Mini ExCEEd Teaching Workshop was adapted to better accommodate the faculty's schedules. The seminar covered pedagogical techniques, adapting to diverse classroom contexts, traditional and active learning approaches, learning theories, and cognitive processes. The two-day ASCE Mini ExCEEd Teaching Workshop was held Thursday, July 24, and Friday, July 25, 2025. The two-day schedule is shown in Table 1 below. Day 1 was held between 7:30 AM and 8:00 PM, and Day 2 was held between 7:30 AM and 5:30 PM. At the end of the workshop, completion certificates were provided.

Table 1. Schedule of Two-day ASCE Mini ExCEEd Teaching Workshop

Time	Type	Topic	Learning Outcome	Room
DAY 1				
7:30-7:55		Welcome, Networking, Breakfast		163-1004
8:00-8:20		Introductions and Background Knowledge Probe	Introduction	163-1004
8:20-9:00	SEMINAR 1	Learning to Teach	Pedagogical	163-1004
9:05-10:05	DEMO 1	Truss Analysis 1	Demonstration	163-2015
10:05-10:35	ASSESSMENT	Assessment of Demo class	Assessment	163-2015
10:35-11:00	BREAK			163-1004
11:00-11:50	SEMINAR 2	Principles of Effective Teaching	Pedagogical	163-1004
12:00-1:00	LUNCH	Boxed lunch, Campus Tour (12:15pm)		2005 > 1004
1:00-2:10	SEMINAR 3	Writing & Speaking	Pedagogical	163-1004
2:10-2:30	SEMINAR 4	Teaching Assessment Worksheet	Assessment	163-1004
2:30-2:45	BREAK			
2:45-4:00	SEMINAR 5	Planning a Class: Learning Objectives	Pedagogical	163-1004
4:00-4:15		Review next day's schedule	Learn-by-Doing	163-1004
4:15-5:00		Prepare for Practice Classes	Learn-by-Doing	2031/2015/2026
5:00-6:00	DINNER	Boxed dinners		2005 > 1004
6:00-8:00		Prepare for Practice Classes	Learn-by-Doing	2031/2015/2026
DAY 2				
7:30-8:10		Announcements, Networking, Breakfast		163-2015
8:10-9:30	SEMINAR 6	Planning a Class: Board Notes	Pedagogical	163-2015
9:30-10:30	SEMINAR 7	Multimodal Learning	Pedagogical	163-2015
10:30-10:45	BREAK			163-1004
10:45-11:35	DEMO 2	Truss Analysis 2	Demonstration	163-1004
11:35-12:00	ASSESSMENT	Assessment of Demo class	Assessment	163-1004
12:00-1:00	LUNCH	Boxed lunch, Engineering Building Tour (12:30pm)		2005 > 1004
1:00-1:30		Prepare for Practice Classes	Learn-by-Doing	2031/2015/2026
1:30-3:30		Practice Classes	Learn-by-Doing	2031/2015/2026
3:30-4:00	BREAK			
4:00-5:00	SEMINAR 8	Interpersonal Rapport	Pedagogical	163-1004
5:00-5:30	WRAP-UP	Workshop Self-Assessment & Completion Certificates	Wrap-up	163-1004
6:00-7:00		Optional Networking Dinner (TBD)		

A total of 5 classrooms were booked to demonstrate how to adapt to diverse classroom contexts and how this affects interactions between instructors and students. See Figure 1.


163-1004, 2026 (48)


163-2005, 2015 (78-82)


163-2031 (48)

Figure 1. Different classrooms booked to demonstrate diverse classroom contexts involving seating arrangements and interactions with the faculty members.
163-1004 (48) indicates building number-classroom (capacity).

04. Methodology

Recruitment: To recruit tenure-track, NTT, and CTC faculty, the ASCE ExCEEd Teaching Workshop was advertised in person and through flyers distributed at the American Society of Engineering Education Pacific Southwest (ASEE PSW) Conference and at the California Engineering Liaison Council (CAELC). Also, emails about the workshop were sent to southern California two- and four-year colleges' engineering departments. The free ASCE Mini ExCEEd Teaching Workshop was available for any full-time or part-time faculty member at a university or community college who teach any engineering related topic. A total of 38 applications were received via Qualtrics; the 32 participants were selected based on a balance of backgrounds.

Setting: The ASCE Mini ExCEEd Teaching Workshop was held at California State Polytechnic University, Pomona (Cal Poly Pomona, CPP); the campus is located 30 miles east of Los Angeles in California. This location was chosen because it was the NSF grant's host institution. CPP's student enrollment is about 53% Hispanic, 22% Asian, 14% White, and 3% African American with the balance composed of other ethnic minorities. Additionally, 46% of the students are female, 57% are first-generation college students, and approximately 40% of the total undergraduate population are transfer students. CPP's educational philosophy is "learn-by-doing," engaging students in hands-on research, scholarship, and creative activities. CPP has a high percentage (41%) of majors in Science, Technology, Engineering, and Mathematics (STEM). CPP ranks highly as a top performer in upward social mobility, ranking #6 in the West, propelling low-income students to financial success by graduating them into rewarding careers.

Data Collection: Knowledge assessment surveys were distributed via Qualtrics to measure participants' knowledge pre- and post-workshop. This research has been approved by the International Review Board (IRB-24-38).

05. Results

The total number of participants provided their feedback (n=32) for both pre- and post-surveys. For the participants, 59% were from four-year institutions (California State University Fullerton and Long Beach, California State Polytechnic University Pomona, San Diego State University, and California Baptist University) and 41% were from two-year institutions (College of the Desert, West Los Angeles College, East Los Angeles College, Orange Coast College, Saddleback College, Santa Monica College, Glendale Community College, Los Angeles Trade Technical College, Los Angeles Pierce Community College, Los Angeles Valley College, Ventura College, and Victor Valley College). Among the faculty, 59% were full-time and 41% were part-time. See Table 2.

Table 2. Type of Institution and Faculty Status

Type of Institution	Number of Faculty	Status	Number of Faculty
Four-year	19 (59%)	Full-time	19 (59%)
Two-year	13 (41%)	Part-time	13 (41%)
Total	32 (100%)	**Total**	32 (100%)

Next, the participants' level of knowledge was measured. The Likert scale was utilized, as not at all familiar, slightly familiar, moderately familiar, very familiar, and extremely familiar, on a 5-point scale. From Table 3, it can be seen from the self-report that the participants' level of knowledge increased significantly (between 13.5% and 48.6%) when comparing the pre- and post-tests, and the variability in their knowledge decreased (between -0.03 and –0.55 in standard deviation), which reduced the knowledge gap between the participants.

Table 3. Participants' Level of Knowledge

No.	Level of Knowledge (n = 32)	Pretest		Posttest	
		μ	σ	μ	σ
1	Lowman's Two-Dimensional Model of Effective Teaching	1.41 (28.2%)	0.82	3.84 (76.8%)	0.79
2	Bloom's Taxonomy of Educational Objectives	2.81 (56.2%)	1.21	4.22 (84.4%)	0.82
3	Classroom Assessment Techniques	3.19 (63.8%)	1.04	3.97 (79.4%)	0.64
4	Learning Objectives	3.91 (78.2%)	0.68	4.59 (91.8%)	0.55
5	Board Notes	2.97 (59.4%)	1.31	4.28 (85.6%)	0.76
6	Multimodal Learning	3.09 (61.8%)	1.26	4.03 (80.6%)	0.73
7	Interpersonal Rapport	2.97 (59.4%)	1.10	4.31 (86.2%)	0.68

For implementation, the following question was asked: "Do you plan to implement any of the topics learned in ASCE Mini ExCEEd Teaching Workshop in any of your future course(s)?"

Participants' response was affirmative: 88% answered "Yes, in F25;" 6% answered "Yes, in S26;" and 6% answered "Yes, after that." The implementation courses are listed in Table 4.

Table 4. Implementation Courses

1000 Level	2000 Level	3000+ Level
Multivariate Calculus Engineering Physics Engineering Graphics Chemistry 102 Electronic Circuit I Principles of Scientific Research Introduction to Engines Elementary Math and Lab Applications	Statics Mechanics of Materials Dynamics Engineering Materials and Properties Engineering Materials and Processing Lab Surveying Lab	Fluid Mechanics Thermodynamics Probability and Statistics Design of Transportation Facilities Low Impact Development in Water Resources Senior Design Project Motor Controls and Programmable Logic Controller Transportation Engineering Geotechnical Engineering

Lastly, participants were asked what type of (1) challenges they anticipated and (2) what additional resources or support they would need to successfully implement lessons learned from the ASCE Mini ExCEEd Teaching Workshop. Table 5 shows the anticipated challenges. Table 6 shows the resources needed. The participants' quotes are organized by topic; some of their typographical or grammatical errors were left as they are to show the original content.

Table 5. Challenges Anticipated

Topic	Participant Quotes
Demos & Storage, Space Limitations, Materials	1. If I were to want to use more props in class, I would need somewhere to store them since I do not have office space and would not want to be carrying it to each class from home. 2. The primary classroom we teach statics in is wide and shallow, with the a/v podium front and center, which severely limits the use of the whiteboard and almost necessitates PowerPoint. While I like the idea of board notes, it just won't work in the classroom. 3. The teaching demo may not fit my students learning style. 4. I anticipate it will be challenging to use more ways such as demos and posters outside of the PowerPoint to teach my class.
Time Management	1. I anticipate the timing may be an issue but as time goes on I will be able to implement the techniques quicker. 2. Time demanding. 3. Shortage of time during lectures and inability to cover all subject matters in the allotted time. 4. Reducing the material load would be challenging to make sure important topics are still covered. 5. Time constrains in still getting through the material while adding the extra activities and demos. 6. Class time limitation; Class size.

	7. There will be a lot of work to prepare the lesson plan to implement the strategies we learned; however, in general, we shall improve our teaching style. 8. This will be my first semester implementing these practices, so I expect there will be a learning curve. In particular, I haven't used board work as much in the past. I'd like to start using multiple colors on the board, but I may begin by adding one color at a time so I don't get overwhelmed. 9. Time management to allow student engagement. 10. I believe there will be time constraints that will limit how much I am able to implement board notes. I also foresee some pushback from students when calling on them directly during class. 11. Number of courses and the variety of courses I am teaching.
Technology, Outdated demos	1. My subjects don't rely heavily on whiteboard use, but I do plan to incorporate it to work example problems. 2. "Boards" work great for live sessions, but it's a lot harder to do for an online, asynchronous course. 3. I feel that using traditional board notes may be somewhat outdated, especially since many students now prefer to use electronic devices for note-taking and reviewing materials. That said, the structure and organization of the course through board notes is still valuable and appreciated, as it helps reinforce core concepts in a clear and methodical way. 4. The availability of technology in my classroom.
Fear, Overwhelm	1. NA. I will teach without fear. 2. Not being able to implement everything at once.
Engagement	1. I will be more dedicated on creating positive classroom environment which indeed is a challenging aspect of teaching. 2. Being able to have more interactive classes while be able to cover all material in a lecture.
Student Learning	1. Paying attention to achieve higher order of learning.
Quality of students	1. Quality of students. We get students with different backgrounds - our own students, transfer students, international students from different countries. It is very hard to keep class GPA. 2. To stop ppl to use their phone or laptops....
None	1. I do not anticipate any challenges. 2. I don't think I will face challenges, other than thinking creatively to implement what I have learned.

Table 6. Additional Resources or Support Needed

Topic	**Participant Quotes**
Demo, Classroom rearrangement	1. Best practices or toolbox. Possibly a reposit of a topic and best practice tool/demo/resource to reinforce topic for students. 2. Demonstration tools and classroom rearrangement for group work. 3. Some more examples of various demos that can be used.
Lecture Notes	1. If CPP can share the lesson resource, we at community college can follow better and prepare better students to transfer. 2. A PDF of the board templates would help tremendously.
Office Space	1. Office space to store models/training aids.

Teaching Tools (Tablet)	1. I hope to learn more about how to effectively implement teaching practices using a tablet and pencil, so that course materials can be easily shared with all students in real time.
Funding	1. Funding for projects and activities.
Models, Lab Equipment	2. Physical models. 3. Our labs are not that recent. We are using old instruments. Moreover, we have only one instrument for each experiment. It limits student engagement and learning as well. 4. Availability of similar large paper poster etc. 5. Have more visual aids available for my students.
Students Coming to Class	1. We need to acknowledge that many students face circumstances that prevent them from attending class in person, whether due to health, transportation, or personal challenges. Even so, it's important that we continue to find ways to support their learning and engagement to the best of our ability.
Support Groups	1. May be establish kind of peer groups on specific topics and courses to share and check each other's work progress. 2. Have CPP make rules and we can all help each other in class...
More Workshop	1. Full 5-day workshop to allow me time to apply and practice my lessons using techniques taught.
Time	1. Time.
None	1. None - it's on me now. Everything was well explained and very doable. 2. Nothing really. I will be reading over the presentations PDFs again and going over the research citations. 3. I think I have everything I need! 4. I think the workshop covered all topics and issues. I can't think of anything else to add.

06. Discussions

The results of this study indicate that the Mini-ExCEEd workshop was effective in increasing participants' pedagogical knowledge and promoting instructional techniques of faculty from two- and four-year institutions. Participants self-reported significant improvements in knowledge across seven instructional topics, with the largest increase occurring where participants originally reported the lowest familiarity, particularly Lowman's Two-Dimensional Model of Effective Teaching (Table 3, No. 1). Moreover, the reduction in standard deviation across the topics suggests that the pedagogical knowledge gap among participants decreased, indicating alignment around a common instructional framework and teaching practices.

The workshop participants were a diverse group with a variety of teaching experience. Six volunteered to prepare and present lessons using board work preparation and engagement techniques, though some reported feeling nervous prior to their presentation. The remaining participants spent significant time preparing board notes and lessons. One participant shared their experience in a Fluid Mechanics course where the topic of viscous head loss in pipes was covered. In the lesson, students measured the inner and outer diameters using Vernier calipers to identify nominal sizes that are standardized in industry, connecting empirical equations to engineering design. Students reported that the hands-on engagement was beneficial. Overall, participants

expressed a strong intent to implement the techniques learned in the workshop with nearly 90% planning to do so in the upcoming semester. It is also worth noting that participants teach a variety of courses (see Table 4), which indicates that the workshop strategies were broadly applicable and not specific to a single course or discipline.

The anticipated challenges were primarily logistical rather than conceptual. Time constraints, classroom layouts, storage for instructional aids, and classroom technology availability were the most frequently cited limitations. In addition, participants expressed concern over balancing extra activities with content coverage while maintaining student engagement. However, some stated that they planned to develop few lectures using the workshop strategies to establish baseline for time management before scaling across the entire semester to ensure proper coverage of important content in an engaging way. Requests for additional resources focused on practical support, including shared archives of demonstrations and board note techniques, physical teaching aids and the funding to create them, peer support groups, and additional workshops.

Workshop participants expressed anxiety about "covering" material inside of course time constraints. When instructors focus on a transmission-oriented model of instruction where learning is measured by absorption of the content delivered, they prioritize breath over depth and exclude alternative pedagogical approaches that require more time and use technology differently. Lower-division courses with high DFW rates may need to be redesigned, focusing on student sense-making and engagement alongside content coverage, to overcome the “gatekeeper” problem. Additionally, teaching-focused faculty who lack offices, storage space, or institutional support for additional professional development have less access to the material resources that would support making improvements in their course instruction methods.

07. Conclusions

The overall findings of this study suggest that short, focused faculty development workshops like the ASCE Mini-ExCEEd Teaching Workshop can produce meaningful improvement in pedagogical knowledge and motivation. Based on participant feedback, future versions of the workshop will likely include a discussion of time-management techniques. However, to achieve long-term, positive impacts on teaching effectiveness, sustained departmental support is needed. Departments should consider ways to address classroom limitation issues revealed in workshop participant feedback, including access to teaching resources (e.g., funding for visual aids and board work). Finally, departments should facilitate post-workshop peer support with opportunities for ongoing collaboration between faculty plus provide a centralized resource of archived demonstration archives for instructors to draw upon as they apply workshop teaching techniques in their classrooms.

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