BOARD # 346: Creating a Community of K-12 Engineering Educators

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Creating a Community of K-12 Engineering Educators: NSF EEC-EWFD-Engineering Workforce Development

Introduction

Founded in 2000 with a grant from NSF (EEC-EWFD-Eng Workforce Development), Teach Engineering (teachengineering.org) is a free digital library of classroom-tested, standards-aligned K-12 STEM resources created in collaboration with educators across the nation. The major goals for the current NSF funded grant are:

- Democratize and broaden the project's classroom impact by creatively supporting K-12 teachers.
- Create a community of practice among K-12 educators to empower teachers to adopt the collection as their own.
- Advance penetration of engineering habits of mind among K-12 youth and educators through strategic partnerships.
- Create tools to optimize the system for the constantly evolving digital landscape.
- Realign the project's lessons and activities with relevant and changing K-12 STEM educational standards, especially NGSS engineering standards and performance expectations.
- Better serve NSF grantees through the publication and dissemination of their original K-12 engineering curricula.

During this past year, management of the library changed organizations and under this new leadership numerous activities and outcomes have occurred towards these goals. For example, activities and video support resources have increased substantially; newsletters and professional development (PD) opportunities have helped create a community of practice among educators; partnerships with like-minded organizations have been cultivated and built-upon; website and project management improvements have been initiated; new resources are standards-aligned; new collection organizations have been established; and NSF RET's were continually supported through webinars and conference sessions.

Poster Focus

This paper and poster will focus on how Teach Engineering is beginning to create a community of practice among K-12 educators through PD opportunities. Research has shown that whether in formal or informal settings, K-12 teachers and influencers need to be trained to bring engineering design into classrooms to increase students' awareness of engineering, and ultimately, interest in and ability to pursue engineering careers [1]. Yet, many successful mathematics and science teachers express that their discomfort with engineering principles is a barrier to using engineering as a means of connecting STEM subjects across curricula [2], [3]. Research shows that K-12 teachers would prefer to use an integrated approach with STEM education, but they do not feel well prepared to implement such an approach [4]. Simultaneously, 80% of assessed PD opportunities do not meet the federal definition of high-quality, leaving a gap in both the content and the quality of available STEM PD for K-12 teachers [5]. The project aims to bridge this gap by offering a variety of asynchronous and in-person PD opportunities in addition to the current

virtual workshops. Each of these three options will provide high-quality opportunities to teachers across the US to help prepare them to successfully implement engineering design thinking into their STEM lessons.

Evaluation Results

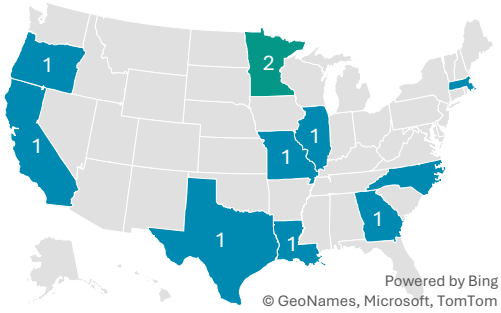
As the new leadership begins to build the variety of PD opportunities, an evaluation framework has been constructed to ensure best practices in delivery and appropriate impacts on participants. In this section, results from the first virtual PD opportunities will be presented. These sessions were conducted in August 2024. The first 2-day session had 80 people sign up with an additional 71 on the waitlist. Although reminders were sent and the waitlisted people were invited to attend, 12 individuals participated in this first session. The second 2-day session similarly had 80 people sign up with an additional 72 on the waitlist and had 15 people attend.

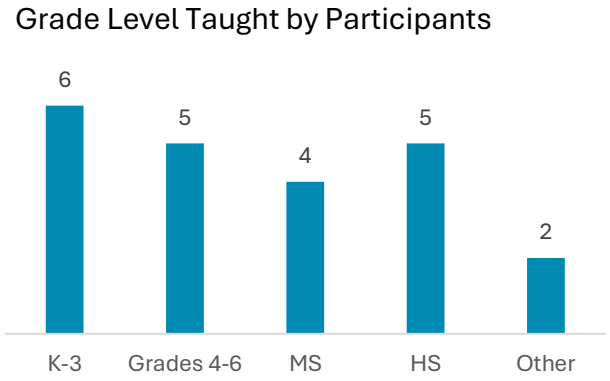
The first session was designed to help educators become more familiar with engineering design, design thinking, and how to implement this in their classrooms while connecting to NGSS standards. Participants explored the engineering design process and phenomena-based learning before diving into creating a new curricular resource with other educators. They also were exposed to different engineering careers, an educational resource Toolkit, and how to create rubrics for open ended engineering projects.

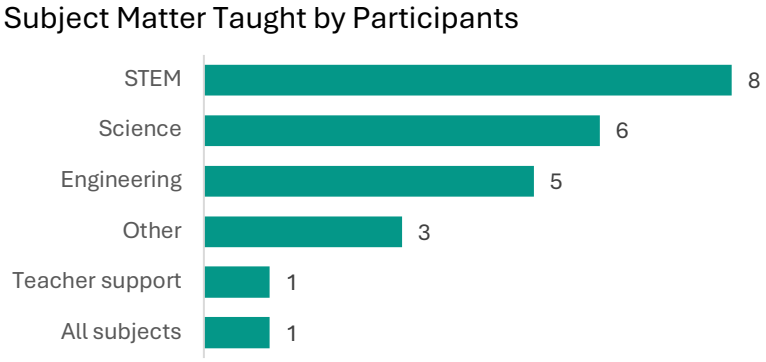
The second two-day workshop was designed to help educators integrate engineering prototyping technologies and design thinking into their STEM classrooms. Participants collaborated with experts in engineering pedagogy and professional development from the University of Colorado Boulder to enhance their skills through a hands-on experience with online engineering design tools. They also engaged in a breakout session focused on the role of engineering design in NGSS, complete with a fun design challenge.

A link to an evaluation survey was sent to each of the participants in both sessions. Six of the 12 (50% response rate) first session attendees responded to the survey request and five of the 15 (33% response rate) second session attendees responded. These responses were combined for analysis when appropriate. The survey was designed to gather information on the participants, the impact of the professional development, the usefulness of the professional development, and feedback on how to improve the professional development opportunities. Due to the small sample size, quantitative and qualitative analyses are limited.

As shown below, the participants were scattered across the US, taught at a variety of grade levels, and primarily teach STEM subjects.







Participant Impacts

Respondents were asked to rate a series of items designed to assess the impact of the PD sessions on their teaching. All respondents agreed or strongly agreed that they know more about engineering resources after the PD sessions; there was a climate of respect for participant experiences, ideas, and contributions throughout the PD sessions; and the PD sessions had a positive impact on their ability to bring engineering design into the classroom. As one attendee responded, "I can't thank you enough for the ongoing support you give to high school teachers. Not only in this course but in your website that is my first stop when looking for ideas and projects!"

Participants were given six retrospective pre/post survey items designed to measure the impact of the PD on their engineering teaching from the perspective of before the PD began and then after the PD was finished. Each item was rated on a five-point scale from 5 = Strongly Agree to 1 = Strongly Disagree. An overall mean score was calculated for the Presurvey ratings and the Post survey ratings. A paired samples *t*-test was conducted on these overall mean scores and revealed a statistically significant increase in ratings from Presurvey to Postsurvey with a large effect size [$t(10) = 3.628$, $p = .002$, $d = .95$].

Survey	*Mean*	*SD*	*t*	*p*	Cohen's *d*
Pre	4.05	.70			
Post	4.61	.47			
			3.628	.002	.95

Due to the low attendance rate, a short survey was sent to the 210 registered individuals who did not attend the PD and 81 completed the survey (39% response rate). When asked why they were unable to attend, 60% indicated a scheduling conflict and 20% indicated unforeseen circumstances. Respondents also indicated that holding the PD in June or July would have increased their chance at attending.

Conclusion

With the change in leadership of the project, the PIs are committed to increasing PD types and opportunities. The limited evaluation results from this first implementation of two virtual PD sessions revealed many positives from the PD itself and some important take-aways regarding timing. The content of the virtual PD is sound and received strong positive ratings from attendees. The results of the non-attendee survey reinforce the need for more options for educators which include asynchronous, in-person, and virtual options. The results also indicate a need for a variety of options regarding timing of these PD opportunities (e.g., 1 hour, ½ day, full day, etc.). The PIs are committed to creating as many options as possible in this next grant year.

Acknowledgement

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References

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