AC 2010-328: SHOWCASING AND SUPPORTING ENGINEERING FACULTY ENGAGED IN TEACHING INNOVATION THROUGH A NEW SYMPOSIUM

Elizabeth Cady, National Academy of Engineering

Norman Fortenberry, National Academy of Engineering

Showcasing and Supporting Engineering Faculty Engaged in Teaching Innovation through a New Symposium

In spring 2009, the National Academy of Engineering (NAE) received funding from the O'Donnell Foundation in order to strengthen the engineering and innovation capacity of the nation by catalyzing a vibrant community of emerging engineering education leaders. The NAE chose to provide a series of symposia that will facilitate learning, broaden collaboration, and promote dissemination of pioneering engineering education research and practice. The target audience for the symposia series is faculty members within 15 years of receipt of their doctoral degrees. The inaugural Frontiers of Engineering Education (FOEE) symposium was held in November 2009. NAE solicited nominations from engineering deans and its membership, and those nominated were invited to complete an on-line application. Approximately two-thirds of those nominated actually applied, and approximately one-third of the applicants (49) were accepted to the inaugural symposium. This paper summarizes the intent and initial outcomes of the 2009 FOEE symposium. It is intended to offer guidance to others who might consider similar meetings.

Overview

The broad outcomes to be achieved by the annual series of FOEE symposia include (a) strengthening the capacity of the attendees to engage in engineering education innovation, (b) facilitating the transition of the attendees into agents of change advancing the U.S. capacity for engineering education innovation, and (c) directly contributing to the advancement of U.S. engineering education. Specific attendee outcomes to be achieved include (a) developing a broad awareness and in-depth knowledge of important and relevant findings from the engineering education and related research communities, (b) building familiarity with relevant effective practices drawn from engineering education, science education, and other professional education communities, (c) increasing awareness of and providing access to resources, networks, and larger frameworks for the improvement of engineering education, and (d) providing exposure to specific instructional and assessment techniques of demonstrated effectiveness across multiple disciplinary domains. The inaugural symposium aimed to recognize innovative work in engineering education while also empowering attendees to higher levels of performance and sophistication in their innovation. Over the long term, the symposia series will document enhanced student knowledge, skills, abilities, and attitudes as well as enhance recruitment, retention, and professional success of United States engineering students resulting from implementation of symposium-catalyzed innovations.

The 2009 symposium consisted primarily of panel presentations with the whole group, affinity group discussions with smaller groups, and networking opportunities. The panel presentations were designed to present information on several topics important to educational innovation. Although the attendees were familiar with most areas, the organizers felt that providing exposure to engineering education research findings and their application to classroom practice as well as information on support systems, working within and beyond one's home institution, and other logistical details of innovation would be useful. The affinity groups were designed to reinforce some material that would relate more directly to attendees' projects as well as allow attendees with similar interests to brainstorm, discuss, and give and receive feedback on the various

innovative ideas. The goal was to provide support for attendees to develop the sophistication of their ideas over the course of the symposium. Overall, the intent of combined activities was to empower faculty who were already leading innovative change in their classrooms to become agents of change in their institution or in the engineering education community at large. This empowerment stems from the information provided as well as the supportive community of practice that developed among attendees. The intent and initial outcomes of the first FOEE symposium are summarized here to offer guidance to others who might consider similar meetings.

2009 Symposium Summary

The inaugural FOEE symposium took place in November, 2009, and included 47 attendees, 7 planning committee members, 2 program evaluators, 4 invited experts, 3 speakers, and several NAE staff members. Attendees were expected to complete some pre-symposium activities in order to define their own long-term goals in engineering education as well as short-term goals for the symposium. The goal of these activities was to encourage attendees to familiarize themselves with each others' work and thus begin the process of forming a cohort. Specifically, they read portions of the book *Educating Engineers: Designing for the Future of the Field* [1] on preparing students to become engineers in the 21st century and the importance of integrating all elements of successful engineering practice in engineering education. In addition, they wrote a short description of an idea or plan for implementing innovative techniques in their classroom. On the basis of these ideas, they were preliminarily placed in one of four affinity groups that stemmed from *Educating Engineers*: design education, engineering fundamentals and analysis, laboratory/ project/ experience-based learning, or ethics/society/broader engineering skills. Attendees were able to attend more than one affinity group session at the symposium.

The organizers strove for a mix of formal and informal networking opportunities, small group discussions, and panel presentations led by organizers, invited experts, and guest speakers. The panel sessions were approximately 75-90 minutes in length and covered topics such as (1) framing the need for and value of innovation in engineering education, (2) what is known about engineering learning, (3) engineering education research, (4) frameworks for sharing and deploying good educational practice, and (5) bringing about organizational change at an institution. These sessions were designed to present information to the attendees that would then inform a large-group discussion.

The networking opportunities included an opening reception, all meals during the symposium, and a "birds of a feather" session in which attendees were encouraged to engage in 5 minute discussions with potential collaborators. The small affinity group discussions were facilitated by the committee members and invited experts. The first two affinity sessions followed the original design, but a feedback session at the end of the first day led to reorganization of the affinity groups to align with six attendee-selected topics: interdisciplinarity (across engineering and other disciplines), first year programs, learning technologies, project/case/hands-on learning, research on design teaching and learning, and scholarship of teaching and learning. These new affinity groups were selected based on their alignment with the ideas for innovations that the attendees wished to pursue. Each affinity group consisted of between 3 and 13 attendees and 1-3 expert coaches. The attendees believed that the new groups would provide them more focused support

for their particular ideas. Affinity group sessions on the second day included the opportunity to meet two-on-one with one of the 12 expert coaches as well as discussions of practical implementation of their ideas, possible barriers to innovation. Attendees were tasked with individually determining their own next steps in their projects in terms of short, medium, and long-term goals.

2009 Symposium Outcomes

The analysis of the evaluation survey as well as follow-up interviews is ongoing, but thus far the evaluation results have been mostly positive. Forty-six of the 47 attendees completed the survey, although some of the questions were skipped by one or more respondents. On a scale of 1 (Extremely Poor) to 9 (Outstanding), with 5 labeled "Mediocre," two-thirds rated the symposium overall as a 7 or 8, and another quarter of the respondents rated it a 6. Other more specific questions included a 4-point scale including "strongly disagree," "disagree," "agree," and "strongly agree." Evaluation results of the scale questions are presented in Table 1.

Table 1. Symposium evaluation results.

Question	Strongly Disagree		Disagree		Agree		Strongly Agree	
	#	%	#	%	#	%	#	%
Symposium overall met expectations	1	**2%**	10	**23%**	19	**44%**	13	**30%**
Reasonable amount of prior readings	2	**4%**	11	**24%**	17	**37%**	16	**35%**
Reasonable amount of prior writing	1	**2%**	3	**7%**	24	**52%**	18	**39%**
Original affinity groups addressed concerns/interests	3	**7%**	16	**36%**	20	**44%**	6	**13%**
Revised affinity groups addressed concerns/interests	1	**2%**	11	**24%**	25	**56%**	8	**18%**
Revised affinity groups enhanced symposium	1	**2%**	3	**7%**	23	**51%**	18	**40%**
Panel sessions broadened understanding	1	**2%**	11	**24%**	25	**56%**	8	**18%**
Panel sessions enhanced symposium	2	**5%**	9	**21%**	23	**52%**	10	**23%**
Sufficient time to establish professional relationships	1	**2%**	7	**16%**	22	**50%**	14	**32%**
Gained understanding of engineering education research	5	**11%**	9	**21%**	22	**50%**	8	**18%**
Gained understanding of engineering education practices	3	**7%**	5	**11%**	24	**55%**	12	**27%**
Gained familiarity with examples of effective innovations to apply	0	**0%**	6	**14%**	24	**55%**	14	**32%**

Question	Strongly Disagree		Disagree		Agree		Strongly Agree	
	#	%	#	%	#	%	#	%
Gained understanding of networks and other resources	0	**0%**	3	**7%**	20	**46%**	21	**48%**
Gained specific skills or techniques to implement	0	**0%**	8	**18%**	26	**59%**	10	**23%**
Established professional peer relationships to pursue	0	**0%**	5	**12%**	19	**44%**	19	**44%**
Comfortable approaching organizers for advice	0	**0%**	4	**9%**	22	**51%**	17	**40%**

The attendees also completed several open-ended questions about the symposium. While the scale responses were mostly positive, attendees provided both negative and positive comments. The questions and number of positive, neutral, and negative comments provided by the attendees are presented in Table 2.

Table 2. Qualitative survey questions and tone of responses.

Question	Positive	Neutral	Negative
Do you have concerns or suggestions about pre-symposium activities?	4	14	23
Please share strengths, weaknesses, and/or suggestions regarding symposium sessions.			
Panel Sessions	2	7	11
Affinity Groups	0	5	5
Networking	2	1	5
Office Hours	4	0	0
Did FOEE meet your expectations? Why or Why Not?			
Attendees/Networking	13	3	1
Topics Covered	4	5	7
Format		5	2
Other	7	2	0
Please discuss strengths, weaknesses, and/or suggestions regarding the symposium overall.	12	10	10

In addition to the questions in Table 2, attendees were asked about the most important learning outcome of the symposium. Seventeen comments related to the resources for engineering education that were presented to attendees. Another 11 comments focused on the networking opportunities with both fellow attendees and the organizers and invited experts. Four comments

related to resources for engineering education research, 3 comments were about leadership, and 2 comments referenced resources for engineering research.

The attendees reorganized the affinity groups using a brainstorming and then group voting exercise. First, all possible ideas were listed, and each attendee then voted on one idea. Those ideas receiving the most votes became the new affinity groups. As indicated, there were six affinity groups identified by the attendees: interdisciplinarity, first year programs, learning technologies, project/case/hands-on learning, research on design teaching and learning, and scholarship of teaching and learning. Although the groups were not even in size and the projects varied widely, many attendees commented on the aid received from others in their group. The interdisciplinary group included projects aiming to integrate information from other fields with engineering courses as well as teaching engineering courses to non-majors. The first year program group focused mostly on redesign of current programs, although support of professors teaching those courses was also discussed. The learning technologies group, which was one of the larger groups with 12 attendees, discussed both broad (e.g., student-customizable curricula, online databases) and specific (e.g., multimedia modules to support learning, video games) technology projects. The project/case/hands-on learning group, the largest group with 13 attendees, discussed modules to impart different skills in engineering courses. Many of these projects also incorporated elements of interdisciplinarity such as combining humanities, social sciences, ethics, or other topics into engineering fundamentals courses. The research on design teaching and learning group discussed tools for assessing student learning, ways of integrating those tools, and using this knowledge to improve teaching. Finally, the scholarship of teaching and learning group discussed education research projects to help understand and improve student learning.

Following several affinity group discussions on the second day, as well as two-on-one discussions with the expert coaches, attendees declared their goals for the next month, for three months out, and for six or more months out. Twenty-nine of the attendees provided their project-related goals. Although the detailed activities differed, there were several themes across the short, medium, and long-range goals. These themes are presented in Table 3. Note that several individuals listed more than one goal in each category.

Table 3. Broad themes of short-, medium-, and long-range goals of attendees.

Goal		**# listing**	**%**
Short-term	Preliminary logistics (e.g., plan, gather material, templates)	13	45%
	Literature review	10	34%
	Find collaborators	9	31%
	Research on assessment methods	8	28%
	Reflection/Review of own work	4	14%
	Compare to similar programs	3	10%
Medium-term	Detailed logistical plans/Prototypes/Pilot studies	19	66%
	Find collaborators	7	24%

Goal		# listing	%
Medium-term	Creating action plan	4	14%
	Writing articles/proposals (internal and external)	3	10%
	Literature review	3	10%
	Teach restructured course	1	3%
Long-term	Develop/Implement project	14	48%
	Submit grant proposal/sustainability	12	41%
	Implement assessments	6	21%
	Develop collaborations	4	14%
	Run research study	3	10%
	Consider broader applications	2	7%

Discussion

The 2009 FOEE symposium addressed many of the broad and specific outcomes listed by the organizers. The survey comments and the goals set by the attendees indicated some increased awareness of both engineering education research and best practices in engineering education. Many of the attendees also commented positively on the networking opportunities afforded by FOEE, and these collaborations and support networks may improve their capacity for innovation in engineering education.

Overall, the inaugural FOEE symposium was successful. Nonetheless, in the spirit of continuous improvement, we strive to improve it for subsequent meetings. Although analysis of the evaluation survey is ongoing, preliminary results indicate high satisfaction among attendees, although there were also many comments with a negative tone that will be considered in planning for future FOEE events. In addition, many attendees stated their interest in participating in the planning process for future symposia. Engaging past participants in future symposia could be a mechanism to encourage "ownership" of the symposium by attendees. It remains to be seen whether attendees will maintain the collaborations begun at the symposium and whether they will complete their innovation projects, although several virtual meetings of attendees have been conducted.

Bibliography

1. Sheppard, S. D., Macatangay, K., Colby, A., & Sullivan, W. M. (2009). *Educating engineers: Designing for the future of the field*. The Carnegie Foundation for the Enhancement of Teaching. Hoboken, NJ: Jossey-Bass.