

A Women's Network for Mentoring Female Engineering Students: Opportunities and Challenges

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Abstract

The Women in Engineering Mentoring Network at the College of Engineering and Applied Sciences (CEAS-WEMN) is one of the initiatives of Western Michigan University's STEP project, a five-year grant from the National Science Foundation (NSF) to improve success and retention of first-year, second-year, and transfer students in engineering. The goal of CEAS-WEMN is to connect female students with women engineering professionals in the region for career support. At about 10% of the population, females are a distinct minority among engineering students. The program began its fourth year in 2013-14 and has expanded its target audience to include female students at all levels, from first-year to graduate students. In this paper, we will report on the structure of our WEMN program as well as on our successes and challenges. We will also present summary data from end-of-year exit surveys completed by mentors and mentees which describe mentoring activities and perceived effects and offer advice to participants and suggestions for program improvement.

1. Introduction

Women continue to be underrepresented in many STEM fields and specifically in engineering. In 2010 women were awarded only 18.4% of engineering degrees (Census 2013, NSF 2013). Even among those holding STEM degrees, women were twice as likely as men to be employed in non-STEM occupations (Landivar 2013 and Gose 2012), and in 2011, about 75% of science and engineering women graduates were not working in STEM occupations. Mentoring has been shown to be one of the most effective tools in students' persistence and academic success (Crisp 2009, Karunanayake 2004, and Nixon 1999). It has also been found that performance and retention of female and underrepresented minority students are increased by having mentors who are also women or minorities, respectively (Marx 2002, Lockwood 2006, and Cheryan 2011).

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Moreover, research suggests that having same-gender or same-race role models can have a strong effect on reducing the disparities in confidence levels for underrepresented groups in STEM fields (Blake-Beard 2011). Accordingly, the focus of our program is on teaming our female STEM students (including URM) with women engineers from area STEM workforce.

2. The CEAS-WEMN Framework

CEAS-WEMN at WMU was created to address the shortage of women engineers in professional practice to alleviate some of the challenges associated with the fact that women are underrepresented in engineering. Specifically, the program aims to increase the success and retention of women in engineering programs by allowing them access to role models from surrounding industry for career information and support. In 2013-14, the program begins its fourth year, having expanded its target audience to include women students at all levels, from first-year to graduate students. Both students and mentors complete applications indicating their field(s) of interest so that matches can be as close as possible. Program involves two formal meetings, one in the beginning of the academic year to introduce the teams to each other, and another one as an exit group meeting in which participants reflect on their experience in the program and complete a formal evaluation survey.

During the academic year, each team decides on the nature of their interaction based on individual preferences and constraints. Table 1 summarizes the relative frequency of interaction and formats over the first three years of the program.

3. Summary of Program Results and Discussion

Results from our program activities include:

- Four-year program participation has increased by 309% for mentees and 236% for mentors. See Table 2. As eligibility has increased, 15 students have participated more than once – 12 for two years and 3 for three years.
- More than 90% of responding mentees from the first three years agreed that (a) it was easy to talk to their mentor, (b) the mentor was supportive of their goals, (c) the mentor showed interest in their career plans, (d) the mentor's field was close enough to their interests to make the experience valuable, and (e) they were happy with the style of mentoring.

- Mentees report on the effects of mentoring in structured and open-ended ways. Ratings of seven possible outcomes, shown in Table 3, show an overall mean described as “quite a bit.”
- Mentees’ certainty about engineering as a career, as rated in the exit survey, shows an overall mean of 8.6 on a 10-point scale. See Table 4.
- Open-ended comments about gains from the mentoring experience range from “what needs to go on a resume” and “how to conduct myself in an interview” to “sexism ... and how to deal with it,” “how to develop and maintain networking relationships,” and “that I have it in me to do this.”
- Retention is higher for the students in the program. Table 5 provides partial results since studies on retention need at least five years to show full impact.
- Some mentees maintain their relationships with their mentors beyond the assignment year, indicating that we truly have created a well-connected network of area professionals and WMU students.

In its fourth year, CEAS-WEMN is a successful program because of mentee interest and mentors’ commitment to working with our WMU women engineering students. On the other hand, there is still room for improvement. Each year, the exit survey asks both mentors and mentees to make suggestions to improve the program. A frequent request from both groups is for more organized activities. Mentors explain it as a way to ensure that mentors and mentees met in person, to offer additional perspectives as through “a day in the life” of different kinds of engineers, to learn from other mentors, and to offer options when mentees hesitate to do so. Mentees requested information about activities on campus, including social activities, which both mentors and mentees could benefit from, while also solving a possible transportation problem. Less frequently, mentors requested needing more guidance on how to mentor; specifically, how to engage the occasional student who doesn’t respond to communications.

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Table 1. Three-Year Mentor Report of Mentoring Activities in numbers, percentiles

Did you ...	Yes	No
a. meet your mentee in person?	26, 96%	1, 4%
b. exchange emails?	27, 100%	--
c. invite your mentee to your work site?	11, 41%	16, 59%
d. invite your mentee to shadow you at work?	3, 11%	24, 89%
e. attend professional meetings/activities with your mentee on campus ?	5, 19%	22, 81%
f. attend professional meetings/activities with your mentee off campus ?	5, 19%	22, 81%
g. attend social activities with your mentee?	10, 37%	17, 63%

Table 2. Four-Year Program Participants

Group	2010-11	2011-12	2012-13	2013-14
Mentees	11	21	32	34
Mentors	11	17	21	26

Table 3. Three-Year Mentee Ratings of Effects of Mentoring on Several Outcomes

Outcome	0 None	1 A little	2 – Quite a bit	3 – Significantly	Mean
a. I better understand engineering in general.	4, 17%	6, 26%	9, 39%	4, 17%	1.6
b. I better understand a few specific fields of engineering.	2, 9%	6, 26%	8, 35%	7, 30%	1.9
c. I better understand the <i>content knowledge and skills</i> I will need.	3, 13%	4, 17%	10, 43%	6, 26%	1.8
d. I am more aware of the <i>interpersonal skills</i> I will need.	3, 13%	3, 13%	9, 39%	7, 30%	1.8
e. I have more insight into how my specific characteristics fit into an engineering career.	1, 4%	4, 17%	13, 57%	5, 22%	2.0
f. I have more self-confidence about my ability to be a successful <i>student</i> .	1, 4%	3, 13%	11, 48%	8, 35%	2.1
g. I have more self-confidence about my ability to be a successful <i>engineer</i> .	1, 4%	3, 13%	11, 48%	8, 35%	2.1

Table 4. Three-Year Mentee Ratings of Certainty About Engineering as a Career

1	2	3	4	5	6	7	8	9	10	Mean
1, 4%	--	--	--	--	1, 4%	--	6, 26%	8, 35%	7, 30%	8.6

Table 5. Results from WEMN Program in Mid-Year 4

Year	# of WEMN Participants	Demographics	Retention of WEMN students to CEAS
Year 1 2010-11	11	All first-year students	<ul style="list-style-type: none"> • 2nd year WEMN retention is 72.7% compared to 50% female students who did not participate and 62.2% for all CEAS students.
Year 2 2011-12	21	<ul style="list-style-type: none"> • 16 first-year students • 5 second-year students 	<ul style="list-style-type: none"> • 2nd year WEMN retention is 81.3% compared to 72% for females who did not participate and 62.2% for all CEAS students.
Year 3 2012-13	32	<ul style="list-style-type: none"> • Freshman 13 • Sophomore 9 • Junior 6 • Senior 3 • Graduate 1 	<ul style="list-style-type: none"> • 2nd year WEMN retention is 92.3% compared to 65.9% for all CEAS students. • This is a retention of 90.6% which is higher than WMU at 73.7% and CEAS at 63.1%.
Year 4 2013-14	35	<ul style="list-style-type: none"> • Freshman 15 • Sophomore 7 • Junior 8 • Senior 5 	To be assessed in Fall 2015.