AC 2007-501: MENTOR: MOTIVATING ENGINEERS THROUGH ORGANIZED RELATIONSHIPS

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ME$_N$TOR: Motivating E$_N$gineers Through Organized Relationships
Year Two Implementation

Introduction

Undergraduate engineering students benefit from exposure to upper-class students and other networking opportunities. ME$_N$TOR (**M**otivating **E**$_N$gineers **T**hrough **O**rganized **R**elationships), a unique and innovative program in year two of implementation at NC State University, links 1400 students in our First Year Engineering Program to 350 co-op students. By working together through ME$_N$TOR first year engineers learn about successfully navigating their freshman year, are exposed to cooperative education, and improve their understanding of the engineering profession. Co-op mentors enhance their professional development as role models, share undergraduate experiences, and participate in a career-building experience. This paper describes the design and second year implementation of the ME$_N$TOR program including lessons-learned and future plans for the retention of engineering students at a large, diverse, research extensive university.

Background [1]

ME$_N$TOR (**M**otivating **E**$_N$gineers **T**hrough **O**rganized **R**elationships) is a ground breaking program in terms of its size and scope, whose aim is to increase student success in engineering through early connections to a positive peer network.[1] In order to understand the strengths, weaknesses, opportunities, and challenges of a program of this magnitude, we benchmarked our plans with peer program data available in the literature. The success of mentoring programs is widely documented, and in the college of engineering at NC State we already had two very successful mentoring programs aimed at women and minorities. Below are details of each of these programs – which formed the basis of our implementation and assessment plan.

START (**ST**udent **A**dvancement **A**nd **R**etention **T**eams) is NC State College of Engineering's mentoring program for minority engineering freshmen and sophomores. An early intervention and peer-mentoring program, START aims to create useful partnerships among minority engineering students. Students are paired by major, demographics, or both with an upper-class minority engineering student. START teams meet on a regular basis to discuss a variety of issues, from choice of classes to securing internships. Social activities are held to allow START mentors to interact with their mentees in a non-academic setting. In 2005-2006 the START program involved 40 mentors serving 276 mentees, and in 2006-07 the program has 25 mentors serving 135 mentees.

WENT (**W**omen **E**ngineers **N**etworking **T**ogether) is the NC State Women in Engineering peer mentoring program, started in 1999 as an all volunteer program to connect first year students with upper class students in the same major. Pairs are matched one-on-one, and participation is totally voluntary, with solicitation of interest made at the beginning of each semester. At the end of the fall semester, pairs are asked to assess their experience, and either member can request a re-matching without prejudice. Pairs are asked to communicate once a week and meet at least once a month. Mentors are given the responsibility for maintaining the relationship and are

provided with a manual about good mentoring relationships, as well as a list of suggestions for activities to which to invite their mentees. Some evening events are held to provide opportunities for the pairs to meet, but more success comes from identifying interesting activities held by professional societies, etc. and designating them a "WENT event." At its height there were sixty mentoring pairs operating. NC State also has the Women in Science and Engineering (WISE) living and learning community. WISE employs upper-class mentors who live in the residence halls with underclass science and engineering students to promote retention and success in these disciplines through mentoring.[2]

In an effort to increase retention and support success, colleges of engineering are now beginning to offer mentoring programs designed for all students – regardless of gender and ethnicity. Two surveys of first-year engineering programs reported by Brannan and Wankat[3] provide examples of peer mentors being used in a variety of roles from tutoring to vertical integration of design throughout the curriculum (this was done by creating teams of first year students mentored by senior engineering students[4]). At Purdue University, peer mentors lead some offerings of the first year engineering seminars.[5] Leadership and mentoring programs have now become available in some programs from freshman through senior year.[6]

Implementation → Year 2 Structure & Expectations

When developing an implementation strategy, it was our intent to create a program that benefited students being mentored, as well as those students serving as mentors. It has been shown that both parties learn through this relationship.[7] With ~1200 new first-semester engineering students as the target audience in Fall 2005 and 1397 in Fall 2006, we knew that there would be challenges. Our biggest challenge continues to be how to replicate the positive aspects of a mentor program on this much larger scale.

To provide mentors for this large number of first-semester engineering students, at a modest 5:1 ratio we need to include a large number of successful upper-class engineering students to serve as mentors. An additional constraint we faced was a zero-dollar budget in the initial Year-1 (Fall 2005) and current Year-2 (Fall 2006) implementation. Given these factors, we quickly converged on the idea of using current engineering students in the cooperative education program and have continued to do so during 2006-07.

ME$_N$TOR Program Structure – Year 2:

1. Each first-semester engineering student at NC State was assigned an upper-class engineering mentor in fall 2006.
2. Continued to utilize engineering students currently in the cooperative education program. In fall 2006 these mentors were either on campus doing their “school” rotation, or were out on a “work” rotation.
3. Each mentee was assigned a mentor based on gender and engineering curriculum of choice. NC State Engineering has 18 engineering majors.
4. The program was implemented in the *E101: Intro to Engineering and Problem Solving* course. All first-semester engineering students are enrolled in this course each fall.

ME$_N$TOR Expectations – Year 2:
At a minimum, for each mentor-mentee pair, one interaction was required specifically related to the Resume Assignment (see Appendix A) in the E 101 course.

Mentee Expectations (1397 mentees were served by the program):

1. Initiate the contact with your mentor.
2. Engage your mentor in the successful completion of the E101 Resume Assignment.
3. Follow through with a list of questions, concerns or issues related to goals that you would like to accomplish during your time at NC State and in engineering.

Mentor Expectations (350 mentors participated in the program):

1. Respond in a timely and professional manner to your mentee upon initial contact.
2. Assist your mentee with the E101 Resume Assignment by providing feedback and input from your experiences as a successful engineering student.
3. Continue with appropriate professional contact with your mentee, utilizing your base of experience at NC State and in engineering.

College of Engineering / Cooperative Education Partnership

There is a recognized need for real-world experiences early in students' college years.[8] At NC State the First Year Engineering Program promotes Cooperative Education as an excellent means to attain these experiences. Although the engineering curricula at NC State does not require participation in Co-op, the First Year Engineering Program and Cooperative Education office have forged a very successful partnership via student exposure during information sessions and more recently through the ME$_N$TOR Program. We have found that co-op students are eager to tell others about their work experience in industry and first-year engineers are eager to learn about co-op.

Advantages of having co-op students as mentors include the opportunity to mentor others as they have been mentored in the work place, thus fostering a spirit of giving back. From the NSPE (National Society of Professional Engineers) Engineer's Creed: *"I dedicate my professional knowledge and skill to the advancement and betterment of human welfare ... to place service before profit …"* [9] Many companies model this ethic by providing mentors for their Co-op students.

Advantages of utilizing co-op students as mentors extend to the mentees themselves. Mentees get connected with a successful engineering student near their age that they can relate to. This allows the mentees to have an individual contact that has "been there and done that." This is a person who has successfully navigated the matriculation process in engineering (a well-established predictor of graduation in engineering), and has achieved success not only in the classroom but also in company research and interviewing processes. During both years of implementation, all mentees were matched with mentors of the same gender and engineering-discipline interests. In this way there were pairings on many levels, and opportunities to make personal and professional connections.

Assessment and Future Plans

Assessment of the ME_NTOR Program was crucial in Year-1 whereby allowing continued quality improvement into Year-2. Participants, both the mentors and the mentees, were encouraged to complete an online questionnaire at the end of each fall semester. The mentees and mentors were given separate surveys. Results are summarized in the tables below.

Table 1: ME_NTOR Program Questionnaire Results for Mentees (N = 350)

Question: *How many times did you interact with your mentor?*

	Year-2	Year-1
✓ 5+	2.6%	6.2%
✓ 4	1.4%	5.1%
✓ 3	4.6%	12.2%
✓ 2	13.7%	28.7%
✓ 1	**50.6%**	20.8%
✓ None	27.1%	27.0%

Analysis: The ME_NTOR Program highly recommended students to contact their ME_NTOR at least once early in the semester. Clearly, most students took this recommendation to heart and interacted with their ME_NTOR exactly one time. Disappointingly, 27.1% did not take advantage of the program.

Question: *Do you feel the* ME_NTOR *Program benefited one or both of you?*

	Year-2	Year-1
✓ Yes	31.7%	40.3%
✓ No	68.3%	59.7%

Analysis: Since all First Year Engineers were assigned a ME_NTOR, we expected this result since some students are familiar with the benefits of networking with upper-class students, whereas, many are still quite reluctant due to stigmas created throughout their secondary education.

Question: *What forms of communication did you have with your mentor? Check all that apply:*

	Year-2	Year-1
✓ Instant Messenger	1.5%	5.9%
✓ (Cell) Phone	2.9%	11.7%
✓ Face to Face	10.1%	17.8%
✓ Email	**85.5%**	64.6%

Analysis: As expected, email was the predominant mode of communication even more so than during Year-1 due to the nature of the assignment (see Appendix A). Positive: more students met their ME_NTOR face to face versus using (cell) phones and IM.

Question: *Are you likely to maintain a relationship with your mentor into the future?*

	Year-2	Year-1
✓ Yes, hopefully	4.9%	6.8%
✓ Maybe	16.8%	24.1%
✓ No, most likely not	78.3%	69.1%

Analysis: These results indicate that we need to improve students' understanding of the long-term benefits and possibilities of staying connected with their mentor.

Question: *Discussing my resume with a* ME_NTOR *was helpful?*

	Year-2	Year-1
✓ Yes	22.7%	24.6%
✓ Somewhat	24.5%	25.9%
✓ No, not at all	12.8%	11.4%
✓ We did not discuss it, but I completed a resume	39.1%	36.2%
✓ I did NOT complete a resume	0.9%	2.0%

Analysis: Almost half of the mentees found value in discussing their resume with a mentor. The program goal was to initially connect the mentor-mentee via this assignment in the hopes their interactions would continue.

Question: *Discussing my Degree Plan with a* ME_NTOR ***would have*** *been helpful?*

	Year-2	Year-1
✓ Yes	30.2%	18.3%
✓ Somewhat	38.5%	25.2%
✓ No, not at all	31.4%	16.3%
✓ We did not discuss it, but I completed a Degree Plan	N/A	38.2%
✓ I did NOT complete a Degree Plan	N/A	2.0%

Analysis: A Year-2 program improvement removed the ME_NTOR requirement from the Degree Plan assignment. It appears we may rethink this strategy into the future.

Question: *Did you discuss anything else with your* ME_NTOR*?*

	Year-2	Year-1
✓ Yes	16.9%	30.2%
✓ No	83.1%	69.8%

Analysis: There is an opportunity to increase the depth of the program in terms of contact and deliverables. The program is clearly beneficial to those mentees that took advantage of the opportunity, but the challenge is to reach those that did not.

Table 2: ME$_N$TOR Program Questionnaire Results for Mentors (N = 119)

Question: *Do you feel the* ME$_N$TOR *Program benefited your mentees?*

	Year-2	Year-1
✓ Yes, all of them	15.1%	11.8%
✓ Yes, some of them	**42.9%**	35.5%
✓ Yes, one of them	13.4%	22.7%
✓ No, not at all	28.6%	30.0%

Analysis: From the mentors' perspective the experience was positive for the mentees. Even more so than Year-1 the older students know that this experience will be beneficial to the mentees in the future.

Question: *What forms of communication did you have with your mentees? Check all that apply:*

	Year-2	Year-1
✓ Instant Messenger	6.2%	7.1%
✓ (Cell) Phone	5.5%	12.5%
✓ Face to Face	6.9%	22.3%
✓ Email	**81.4%**	58.2%

Analysis: As expected, the vast majority of interaction was via email (see Appendix A: Resume Assignment).

Question: *Are you likely to maintain a relationship with any of your mentees into the future?*

	Year-2	Year-1
✓ Yes, hopefully	2.5%	5.7%
✓ Maybe	10.1%	15.9%
✓ No, most likely not	87.4%	78.5%

Analysis: This represents an opportunity for improvement. Year-2 data is even more discouraging than Year-1 results.

Question: *Do you believe it is helpful for First Year Engineers to discuss resumes with an upper-class* ME$_N$TOR*?*

	Year-2	Year-1
✓ Yes	**63.3%**	49.5%
✓ Somewhat	27.4%	39.3%
✓ No, not at all	9.4%	11.2%

Analysis: This is very encouraging, but represents an opportunity for improvement since the mentees feedback was not in line with this belief.

Question: *Do you believe it **would be** helpful for First Year Engineers to discuss degree plans (including interesting courses, instructor choices, opportunities like co-op, etc.) with a* ME$_N$TOR*?*

	Year-2	Year-1
✓ Yes	**71.3%**	68.9%
✓ Somewhat	21.7%	26.2%
✓ No, not at all	7.0%	4.9%

Analysis: These results demonstrate the mentors' opinion on the importance of degree planning.

Question 6: *Did you discuss anything else with your mentee(s) other than their resume?*

	Year-2	Year-1
✓ Yes	44.5%	50.0%
✓ No	55.5%	50.0%

Analysis: Clearly, over 50% of the pairs missed the opportunity to forge a stronger relationship. This is viewed as another opportunity for improvement.

Question: *Do you believe an organized relationship with a* ME$_N$TOR *would have been helpful when you were a First Year Engineer?*

	Year-2	Year-1
✓ Yes, it would have been helpful	**39.5%**	38.5%
✓ Yes, somewhat helpful	**39.5%**	33.9%
✓ Maybe, for other students	12.6%	21.1%
✓ No, not at all	8.4%	6.4%

Analysis: Most of Year-2 mentors did not have a ME$_N$TOR Program available when they were first-semester engineers. On reflection, almost 80% believe it would have been helpful to have a mentor during their first semester. This re-enforces the existence of the ME$_N$TOR Program.

Overall, the ME$_N$TOR Program has great potential for developing First Year Engineers; however, similar to Year-1, the Year-2 results of the program have been mixed. Considering the analysis above and following candid discussions with students the following aspects of the ME$_N$TOR Program were identified for improvement during Year-2 to increase the quality of the experience for both mentees and mentors alike.

1. **Develop a website that enables ME$_N$TOR participants to look up their mentor/mentee contact information.** This resource became available during early summer 2006 in time for New Student Orientation (August). This website was the single biggest quality improvement for Year-2 implementation whereas it allowed mentor-mentee pairs to get linked early and easily at the beginning of the semester. Website: ***http://www.engr.ncsu.edu/students/mentor/***

2. **Prospective, and current, upper-class co-op mentors must embrace ME$_N$TOR as part of their co-op experience.** During Year-2 the culture of Cooperative Education evolved to include the expectation of mentoring First Year Engineers. Some of the Year-1 mentees became the Year-2 mentors. We contacted mentors early in the summer to discuss expectations which also furthered the educational process.

3. **Develop an event that encourages ME$_N$TOR participants to meet one another.** While a specific event was not created to pair the mentor-mentees due to logistical challenges, constant and continued encouragement via the *E101: Introduction to Engineering & Problem Solving* course did occur.

4. **Request corporate sponsorship to develop a budget for sustainable growth of the program.** Efforts were made to identify funding sources, however, to no avail. Our rationale for professional growth of the co-ops, and the pitch to private industry regarding their corporate visibility to First Year Engineering students was not enough to develop a budget for sustainable growth into the future.

References

1. J.Lavelle, B.Koehler, M.C.Robbins, and S.Matney. (2006). "ME$_N$TOR: Motivating E$_N$gineers Through Organized Relationships," Proceedings of the 2006 ASEE National Conference, Chicago, IL, June 2006.

2. S. A. Rajala, et al. (2004). "The North Carolina State University Women in Science and Engineering Program: A Community for Living and Learning," Proceedings of the 2004 ASEE National Conference, Salt Lake City, UT, June 2004. Available on-line at <http://www.asee.org/acPapers/2004-633_Final.pdf>.

3. K. Brannan and P. Wankat (2005). "Survey of First-Year Programs," Proceedings of the 2005 ASEE National Conference, Portland, OR., June 2005. Available on-line at < http://www.asee.org/acPapers/2005-236_Final.pdf>.

4. J. Hochstein and W. Janna (2005). "Freshman-Senior Collaboration in a Capstone Design Course," Proceedings of the 2005 ASEE National Conference, Portland, OR, June 2005. Available on-line at <http://www.asee.org/acPapers/2005-411_Final.pdf>

5. L. Katehi, et al. (2004). "Preeminence in First-Year Engineering Programs," Proceedings of the 2004 ASEE National Conference, Salt Lake City, UT, June 2004. Available on-line at <http://www.asee.org/acPapers/2004-1392_Final.pdf >.

6. W. Rochefort (1998). "Leadership and Mentoring in Undergraduate Engineering Programs," Proceedings of the 1998 ASEE National Conference, Seattle, WA., June 1998. Available on-line at <http://www.asee.org/acPapers/00356.pdf>.

7. C. Muller (2002). " The Under-representation of Women in Engineering and Related Sciences: Pursuing Two Complementary Paths to Parity," A Position Paper for the National Academies' Government University Industry Research Roundtable Pan-Organizational Summit on the U.S. Science and Engineering Workforce. Available on-line at <https://www.mentornet.net/Documents/Files/GUIRR.pdf>.

8. P. Wankat and F. Oreovicz (2005) "Teaching: Starting With Square One", Connections, the American Society for Engineering Education's e-newsletter, December 2005.

9. "NSPE Code of Ethics for Engineers Engineers' Creed," At National Society of Engineers website, http://www.nspe.org/ethics/eh1-cred.asp, 1-12-06.

Appendix A: Resume Assignment

1. Create / revise your current resume. Review it with your ME$_N$TOR.
Deliverable: Submit a hard copy in class (attach email or feedback from mentor).

Note: Contact / Meet with your mentor to introduce yourself. Ask them to review or offer feedback about your Resume. Perhaps your mentor will share his/her resume with you?

2. Create a future resume.
Deliverable: Submit a hard copy in class.

Note: 3 years from now you will be applying for full-time engineering jobs to begin your professional career. Include experiences you intend to have by that point in time.

3. Set-up your personal "profile" in ePack.
Deliverable: Print & Submit login page (the page immediately following login).

- ePack is hosted by the University Career Center.
- ePack is the university-wide system that connects employers with students.
- We encourage you to use the system in order to maximize your success.

Optional: Upload your resume via ePack and visit the University Career Center.

- Located on the 2nd Floor Pullen Hall
- Website at http://www.ncsu.edu/career/

Other optional activities that may be of interest:

Participate in the **Engineering Career Fair**, and on-campus interviewing (i.e. yes, companies come here to campus).