2006-642: MENTOR: MOTIVATING ENGINEERS THROUGH ORGANIZED RELATIONSHIPS

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ME$_N$TOR: Motivating E$_N$gineers Through Organized Relationships

Introduction

In the fall semester of 2005 the First Year Engineering Program at North Carolina State University initiated a new and exciting mentoring program for all ~1200 of our first-semester engineering students. ME$_N$TOR (Motivating E$_N$gineers Through Organized Relationships) is a groundbreaking 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. The successes of mentoring programs is widely documented in the literature, and indeed in the college of engineering at NC State we have two very successful mentoring programs aimed at women and minorities. The motivation for initiating the ME$_N$TOR program was to extend these successes, and to provide a mentoring experience for all ~1200 of our entering first-semester engineering students. This paper describes the background, implementation, assessment, and future plans of the program.

Background

In order to understand the strengths, weaknesses, opportunities, and challenges of a program with the scope and size of the ME$_N$TOR Program, we benchmarked our plans with peer program data available in the literature. In addition, we looked at the components of our existing mentoring programs for women and minority engineers. Below are details of each of these programs – which formed the basis of our implementation and assessment plan.

Peer mentoring programs of various kinds have been part of engineering programs for a number of years.\(^1\) Initially such programs were focused on underrepresented minorities and women in engineering.\(^2\) At NC State, the Minority Engineering and Women in Engineering Programs have provided mentors for students served by their offices.

START (STudent Advancement And Retention Teams) 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 mentors act as big brothers/sisters to mentees. 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 involves 40 mentors serving 276 mentees.

At NC State, the Women in Engineering peer mentoring program, WENT (Women Engineers Networking Together) was 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 rematching 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.

However, 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 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). At Purdue University, peer mentors lead some offerings of the first year engineering seminars. Leadership and mentoring programs have now become available in some programs from freshman through senior year.

**Implementation**

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. With ~1200 new first-semester engineering students as the target audience, we knew that there would be challenges. However, our experience with mentoring programs in the engineering women’s and minority student programs demonstrated the powerful possibilities for both sets of students. Our challenge was to replicate the positive things that we knew about mentoring on this much larger scale.

As described above, our engineering women and minority offices have mentoring programs for first-semester students. We wanted to continue these programs as they existed, and “add” the component of providing mentors for students not served under the existing mentor programs. To provide mentors for ~1200 new students at a 10-to-1 ratio meant that ~120 mentors were needed, and at a 5-to-1 ratio it meant that 240 mentors were required. Thus, it was clear that we would need access to 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 fall 2005 implementation. Given these factors, we quickly converged on the idea of using current engineering students in the cooperative education program. After discussions with the coop office the following MEnTOR Program structure was developed:

**MEnTOR Program Structure:**

1. Each first-semester engineering student at NC State would receive an upper-class engineering mentor in fall 2005.
2. Students covered under the existing Minority Engineering mentoring program would continue to operate as they have in the past.
3. Students not previously covered under existing mentoring programs would be mentored under the MEnTOR Program.
4. Utilize engineering students currently in the cooperative education program. In fall 2005 these mentors were either on campus doing their “school” rotation, or were out on a “work” rotation.
5. Each mentee was assigned a mentor based on gender and engineering curriculum of choice. NC State Engineering has 18 engineering majors.
6. The program was implemented in the E 101: Introduction to Engineering and Problem Solving course. All first-semester engineering students are enrolled in this course.

**Expectations:** At a minimum two interactions were required for each mentor-mentee pair related to specific assignments in the E 101 course:
1. Resume Assignment (see Appendix A).
2. Plan of Study (Progress Toward Degree) (see Appendix B).

**Mentee Expectations (~1200 mentees were served by the program):**
- Initiate the contact with your mentor.
- Engage your mentor in the successful completion of the two E 101 assignments that require mentor involvement.
- 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 (280 mentors participated in the program):**
- Respond in a timely and professional manner to your mentee upon initial contact.
- Assist your mentee with the two E101 assignments by providing feedback and input from your experiences as a successful engineering student.
- Continue with appropriate professional contact with your mentee, utilizing your base of experience at NC State and in engineering.

**The Engineering-Co-op Partnership**

The NC State First Year Engineering Program and Co-operative Education office have forged a very successful partnership through the ME_NTOR Program. We knew that Co-op students were eager to tell others about their work experience in industry – there is an existing ambassador program through which students share their experiences. These ambassadors speak to potential and new students and parents at University Open House and employers at Co-op Job Fairs. As such, professionalism, outreach, and mentoring-type activities were already part of the Co-op culture. The Co-op students became a natural pool of mentors for the ME_NTOR Program.

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 ...” Many companies model this ethic by providing mentors for their Co-op students. Insight provided from an engineer who is not the direct supervisor is often noted in student reports. In addition, when Co-op students serve as mentors they are challenged to assess their own growth and development (personal and professional).
Advantages of using Co-op students as mentors extends 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 who 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. 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.

There is a recognized need for real-world experiences early in students’ college years. At NC State, the First Year Engineering Program promotes Cooperative Education as an excellent means to attain these experiences. In the engineering curricula at NC State participation in Co-op is not required. Another positive aspect of the ME_NTOR Program is the awareness that is created about the Co-op Program. Through ME_NTOR, all ~1200 new first-semester students meet and find out more about a current Co-op student. This helps to promote the program and the benefits of participation.

Assessment and Future Plans

Assessment of the ME_NTOR Program is crucial for continued quality improvement; therefore, all participants were encouraged to complete an online questionnaire at the end of the fall semester. This included both the mentors and the mentees. The mentees and mentors were given separate surveys. These consisted of both quantitative and qualitative questions. Results are summarized in the tables below.

Table 1: ME_NTOR Program Questionnaire Results for Mentees

<table>
<thead>
<tr>
<th>Question 1: How many times did you interact with your mentor? (N = 467)</th>
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<tbody>
<tr>
<td>✓ 5+ (6.2%)</td>
</tr>
<tr>
<td>✓ 4 (5.1%)</td>
</tr>
<tr>
<td>✓ 3 (12.2%)</td>
</tr>
<tr>
<td>✓ 2 (28.7%)</td>
</tr>
<tr>
<td>✓ 1 (20.8%)</td>
</tr>
<tr>
<td>✓ None (27.0%)</td>
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</tbody>
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Analysis: The ME_NTOR Program highly recommended students to see their ME_NTOR at least twice throughout the semester. Clearly, most students took the recommendation to heart and saw their ME_NTOR once or twice. Disappointingly, 27% did not take advantage of the program, whereas, 23.5% took full advantage.

<table>
<thead>
<tr>
<th>Question 2: Do you feel the ME_NTOR Program benefited one or both of you? (N = 467)</th>
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<tbody>
<tr>
<td>✓ Yes (40.3%)</td>
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<tr>
<td>✓ No (59.7%)</td>
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</tbody>
</table>

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 3:** What forms of communication did you have with your mentor? \((N = 556)\)

*Check all that apply:*

- Instant Messenger (5.9%)
- (Cell) Phone (11.7%)
- Face to Face (17.8%)
- Email (64.6%)

**Analysis:** As we expected, email was the predominant mode of communication. However, we were pleased that the results indicated more students saw their MENTOR face to face versus using (cell) phones and Instant Messenger.

**Question 4:** Are you likely to maintain a relationship with your mentor into the future? \((N = 457)\)

- Yes, hopefully (6.8%)
- Maybe (24.1%)
- No, most likely not (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 5:** Discussing my resume with a MENTOR was helpful? \((N = 456)\)

- Yes (24.6%)
- Somewhat (25.9%)
- No, not at all (11.4%)
- We did not discuss it, but I completed a resume (36.2%)
- I did NOT complete a resume (2.0%)

**Analysis:** Our thought was that connecting through the resume assignment would enable positive interaction on this assignment, as well as other overall connections. Clearly, this is an area for future improvement.

**Question 6:** Discussing my Degree Plan with a MENTOR was helpful? \((N = 448)\)

- Yes (18.3%)
- Somewhat (25.2%)
- No, not at all (16.3%)
- We did not discuss it, but I completed a Degree Plan (38.2%)
- I did NOT complete a Degree Plan (2.0%)

**Analysis:** As with the Resume Assignment above, this appears to be an area for improvement in the future.

**Question 7:** Did you discuss anything else with your MENTOR? \((N = 467)\)

- Yes (30.2%)
- No (69.8%)
Analysis: These results point to the fact that there are opportunities to increase the depth of the program in terms of contact and deliverables.

**Question 8:** *If you had to describe the MEnTOR Program in one word, what is it? (N=461)*
- Positive-oriented Word (125 responses, 27.1%)
- Neutral-oriented Word (38 responses, 8.2%)
- Negative-oriented Word (182 responses, 39.5%)
- No Comment (116 responses, 25.2%)

Analysis: The MEnTOR Program was different things to different students. The program is clearly beneficial to those mentees that took advantage of the opportunity to speak with an upper-class mentor, however, the challenge is to reach out to those that did not.

**Question 9:** *What was the most valuable aspect of the MEnTOR Program?*
- Responses: They enjoyed the experience of having the advice of an experienced upper-classman about classes and professors. Mentors helped the students become more comfortable in a large urban university setting.
- Negative-themed responses: Criticisms were related to not getting connected with their mentor in a timely fashion or never responded, and the mentor not being very helpful (too busy, not interested).

**Question 10:** *What was the least valuable aspect of the MEnTOR Program?*
- Responses: Criticisms were related to not getting connected with their mentor in a timely fashion or the mentor never responded, also the mentor not being very helpful (too busy, not interested). In addition, students mentioned lack of organization in the program, and the impact (value-added) when a connection was there, was minimal.

**Question 11:** *How could have the relationship with your mentor been improved?*
- Responses: Students mentioned face-to-face meeting, and having structured and consistent contact as ways to improve the relationships.

Table 2: MEnTOR Program Questionnaire Results for Mentors

<table>
<thead>
<tr>
<th>Question 1: <em>Do you feel the MEnTOR Program benefited your mentees? (N = 110)</em></th>
</tr>
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<tbody>
<tr>
<td>Yes, all of them (11.8%)</td>
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<tr>
<td>Yes, some of them (35.5%)</td>
</tr>
<tr>
<td>Yes, one of them (22.7%)</td>
</tr>
<tr>
<td>No, not at all (30.0%)</td>
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Analysis: These results indicate that from the mentors’ perspective the experience was
positive for the mentees. Perhaps the older students know that this experience will be beneficial to the mentees in the future. It is just that the mentees can’t see that yet.

**Question 2:** *What forms of communication did you have with your mentees? (N = 110)*

Check all that apply:

- Instant Messenger (7.1%)
- (Cell) Phone (12.5%)
- Face to Face (22.3%)
- Email (58.2%)

**Analysis:** It is very positive to see the interactions are occurring through mixed mode. It is especially positive to see the face-to-face interactions.

**Question 3:** *Are you likely to maintain a relationship with any of your mentees into the future? (N = 107)*

- Yes, hopefully (5.7%)
- Maybe (15.9%)
- No, most likely not (78.5%)

**Analysis:** This represents an opportunity for improvement.

**Question 4:** *Do you believe it is helpful for First Year Engineers to discuss resumes with an upper-class Mentor? (N = 107)*

- Yes (49.5%)
- Somewhat (39.3%)
- No, not at all (11.2%)

**Analysis:** This represents an opportunity for improvement.

**Question 5:** *Do you believe it is helpful for First Year Engineers to discuss degree plans (including interesting courses, instructor choices, opportunities like co-op, etc.) with a Mentor? (N = 103)*

- Yes (68.9%)
- Somewhat (26.2%)
- No, not at all (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 and/or degree plan? (N = 110)*

- Yes (50.0%)
- No (50.0%)

**Analysis:** Is the cup half full or half empty? Clearly, 50% of the pairs missed the opportunity to forge a stronger relationship. This is viewed as another opportunity for...
Overall, the ME_N TOR Program has great potential for developing First Year Engineers; however, the Year-1 results of the pilot program have been mixed. Considering the analysis above and following candid discussions with students we feel the following aspects of the ME_N TOR Program can be improved upon for fall 2006 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 may become available during the admission process or at New Student Orientation (August). This allows mentor-mentee pairs to get linked early and easily at the beginning of the semester.

2. Prospective, and current, upper-class co-op mentors must embrace ME_N TOR as part of their co-op experience. Continue to evolve the culture of Cooperative Education to include the expectation of mentoring First Year Engineers. Contact mentors early in the summer to discuss expectations and offer (in)tangible benefits will also further the education process. Provide mentor training and mentoring resources to the Co-op students to increase their efficacy.

3. Develop an event that encourages ME_N TOR participants to meet one another. Continue encouragement via the E101: Introduction to Engineering & Problem Solving course.

4. Request corporate sponsorship to develop a budget for sustainable growth of the program. Base rationale on professional growth of co-ops and the corporate awareness (visibility) of First Year Engineering students.

References


Appendix A: Resume Assignment

1. Create / revise your personal resume.

   Deliverable: Submit a hard copy in class.

2. Set-up your personal "profile" in the e-Pack system.

   Deliverable: Print & Submit login page.
   ✓ 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.
   ✓ Click here for "How to use ePack effectively"

3. Optional: Upload your resume via ePack and visit the University Career Center
   ✓ Map: Located on the 2nd Floor Pullen Hall
   ✓ Website at http://www.ncsu.edu/career/

Other optional activities that may be of interest:

(1) Using the "Career Events" link on the University Career Center homepage become aware of the various workshops (i.e. resume writing), Career Fairs (i.e. Engineering Career Fair is February 2, 2006), and on-campus interviewing (i.e. which companies are here on campus).

(2) Using the "Majors and Careers" link review the information under What Can I do with a Major in?
Appendix B: Plan of Study (Progress Toward Degree)

Complete a Plan of Work (available under “Degree Audit” through the Pack Tracks link) for your first two years at NC State.

1. **Print and turn in a hard-copy the following:**
   - The complete plan in “semester by semester” display. Clearly note on the display the exact month and year you plan to matriculate.  
     (30 points)
   - Ask your upper-class mentor to review your plan of study. Turn in your plan with either 1. An approval signature from your mentor, or 2. An email correspondence between you and your mentor discussing your degree plan.  
     (20 points)

   *NOTE: Final plans are graded based on completeness (i.e. Have you included all the courses required of you? Did you account for Pre-requisites?, etc.).*

2. **Print three jobs descriptions in your field/company of interest**
   - Indicate the required education, recommended experience, and the (general) salary being offered if these do not appear on the printed page.  
     (25 points)

3. **Do one of the following:**
   - Print a description page for each of three graduate programs (at any University) that offer study in your area of interest (i.e. Engineering, Business, Medicine, Law, Optometry, Dentistry, etc.).  
     (25 points)
   - Print/Submit the first page for a minor here at NC State University you may pursue. Also, print the first page of two more minors that look interesting.  
     (25 points)
   - Submit the curriculum page for a second major here at NC State University that you may pursue. Note on this sheet the requirements for admission into this 2nd degree. Circle all courses that are above and beyond your first major.  
     (25 points)