Enhanced Connections: Making Changes to Mentoring Programs for Science and Engineering Graduate Students

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Abstract—The paper describes changes to an existing mentoring program for STEM (Science, Technology, Engineering and Mathematics) graduate students. We made the changes after feedback suggested that our participants had a hard time fitting mentoring in to their busy lives. The changes include: increased levels of interaction with the participants via email, revisions to the format and topics of events, and revisions of the mentoring handbook. The results from program evaluations are presented and indicate that recent changes have had positive effects on retention of participants and levels of interaction between mentees and mentors.

Introduction

Mentoring of graduate students in STEM is one way to ensure student success (Allen et al 2004, Davidson & Foster-Johnson 2001, Green & Bauer 1995, Tenenbaum, Crosby & Gliner 2001, Waldeck et al 1997). Because of this, it is important to continue to evaluate and improve existing mentoring programs. The Center for Workforce Development (CWD) at the University of Washington developed a mentoring program for female STEM graduate students in 1998. Subsequently, the mentoring program has evolved to work with a wider group of students.

Over the last few years, CWD has made significant changes to these mentoring programs. The changes were motivated by feedback from participants in addition to thoughtful consideration of our program. We wanted to make it easy for our participants to fit mentoring relationships into their already busy lives, provide students with more information about the issues that graduate students in STEM fields face, and allow for network mentoring opportunities. The changes we have made are three-fold: (1) increasing email contact with mentoring participants, (2) changing the format and types of events and workshops and (3) modifying the mentoring handbook.

We have evaluated the changes to our program in multiple ways. Looking at our annual evaluation and attendance patterns at events allows us to track changes in participants' experiences over time. We also have anecdotal evidence from participants supporting the changes. By looking at these sources of information, we are able to evaluate the changes to our program and make recommendations for other mentoring programs.

Literature Review

Much of the research on mentoring focuses on the traditional type of mentoring relationship that consists of one mentor and one mentee. Benefits of mentoring are more likely to accrue under positive mentoring relationship conditions. Although the importance of mentoring has been

established, there is tension between being involved with mentoring and engineers' already busy lives.

Mentoring is a common strategy used in higher education to provide socialization to female graduate students (Antony & Taylor 2004, Clark & Corcoran 1986, De Janasz & Sullivan 2004, Turner & Thompson 1993), but also for the purposes of increasing retention and helping the students succeed (Austin 2002, Chesler & Chesler 2002). There are two main functions of a mentoring relationship: to provide career and instrumental support and to provide psychosocial support (Allen et al 2004, Kram 1985, Noe 1988). Students that are part of formal mentoring programs have higher graduation rates than their peers, greater satisfaction and productivity (Cosgrove 1986, Girves, Zepeda & Gwathmey 2005, Tenenbaum, Crosby & Gilner 2001, Waldeck et al 1997).

Some researchers hypothesize that socialization through traditional mentoring is not enough, and that programs must develop and implement additional ways to help students learn what it means to be a faculty member (Austin 2002). Additionally, other authors argue that traditional one-on-one mentoring may not provide all the benefits for women and people of color specifically, and that other types of mentoring would be helpful in this regard (Chesler & Chesler 2002).

Having multiple mentors increases the network of people that a mentee can get advice and socialization from, as well as increases the instrumental opportunities available (Baugh & Scandura 1999, Higgins 2000). With network mentoring, a person has more than one person who can serve as a mentor for them. Network mentoring is not hierarchical. Anyone in the network can serve as a mentor for someone else, and at the same time get assistance from a different mentor (Haring 1999). So, it is ideal that graduate students have access to different types of mentoring in their careers.

The program modifications were motivated by observations that our participants felt busy and this hindered their participation. This is not out of alignment with the literature on STEM fields; balance between family and careers is an important issue, particularly in the literature on women in STEM. Scientists and engineers are known to work long hours, especially those in academic fields (Epstein 2005). Furthermore, women scientists report that one of their largest stressors is balancing the demands of their career with that of their family (Ivie, Cuzjko, & Stowe 2001, Rosser 2004). Given that scientists feel this sort of pressure, it is not surprising that they feel too busy to take on more work by participating in a mentoring program.

The literature clearly suggests that the experience of participation within a mentoring program can be extremely beneficial for STEM graduate students. Despite this, both mentees and mentors in STEM fields feel overly busy. One of our challenges as a program is to ensure that graduate students can have the experience of a mentoring relationship without stressing the time demands of our mentees or mentors.

Background
The Center for Workforce Development has been offering mentoring programs for graduate students since 1998. The Faculty and Graduate Student Mentoring Program (FacGrad), our first mentoring program, was developed for female graduate students interested in faculty careers.

Since that time, our program staff has worked with various academic units on campus, including the Center for Nanotechnology, the Chemistry Department, and the Electrical Engineering Department to accommodate graduate students interested in careers in industry. Furthermore, we have also expanded our focus to include underrepresented minorities in STEM fields.

The goals of the mentoring program include: providing graduate students with personal and career guidance, enhancing retention of students pursing STEM degrees, preparing grad students with realistic viewpoints of career options, and utilizing mentors' expertise for the professional development of STEM grad students. The breadth of the program goals speaks to the wide range of issues dealt with through the mentoring relationships and through programmatic information.

The program is advertised widely to graduate students in STEM fields. New mentees fill out an application that asks about their background and their goals in a mentoring relationship. Using this information, the organization can identify an appropriate mentor from among existing identified faculty and industry mentors or recruit a new mentor appropriate for the student.

In fall quarter, mentees and mentors are invited to our annual Mentoring Orientation. At this session, participants receive handbooks and the program staff discusses ways to establish and maintain successful mentoring relationships. If a pair is matched during another quarter, we mail them handbooks and tips about initiating a mentoring relationship. All new mentoring pairs are encouraged to read the handbook, think about their expectations of the mentoring relationship, and fill out a "Mentoring Agreement" to outline the parameters of their relationship.

Over 180 students have participated in the mentoring program. Many of these students participated in the program for multiple years. The majority of all mentees, approximately 75%, have been women. Although more than a third of the mentees have been Asian or Pacific Islander, less than 10% of all participants have been from ethnic groups that are underrepresented in STEM fields. Almost one third of participants have been international students, with the majority coming from Southeast Asian countries such as China and Thailand.

Programmatic Changes
Although our program has historically been successful, we are constantly making adjustments to the program. This paper focuses on recent changes to the program. In this time, we have made efforts to be in closer contact with our mentoring pairs and to help them learn about having successful mentoring relationships. In addition, we have changed the format and focus of our events and revised our handbook to make it more meaningful and accessible.

More Frequent Contact
Prior to the changes, participants were invited to events throughout the year and received periodic emails about activities on campus, but had few interactions with mentoring program staff other than that. In the past three years, program staff has made targeted attempts to be in closer contact with participants. We did this because (1) annual evaluation results indicated that many participants were never or rarely in contact with their mentors and (2) many participants indicated that they felt too busy to participate in the program. We hoped that by being in touch with participants, we would remind them to be active mentees or mentors. During the 2004-2005 school year, we began checking in regularly with each mentoring pair and sending monthly

emails with articles on professional development topics. In 2005-2006, we began sending the emails with professional development articles semi-monthly. In 2006-2007, we instituted an additional monthly email on developing and maintaining successful mentoring relationships.

Each quarter, every pair receives an individualized email that serves as a check-in. These emails ask participants whether they are in contact and if we can help them. These emails serve as a reminder to mentees and mentors to be in contact with each other and help keep us informed about their relationships. When these emails are sent, upwards of half of the mentoring pairs reply. If we do not hear from a mentoring pair one quarter, we often find that we hear from them the following quarter. Often, participants write back expressing appreciation for checking in with them or saying that they will get in contact soon with their mentee or mentor.

The semi-monthly topical emails were started for similar reasons – to help mentees and mentors stay in contact. By containing information about professional and personal development of graduate students, they are also meant to spark conversation. A comment from a mentee about not knowing what to discuss with her mentor, paired with evaluation data that suggested mentees and mentors did not have frequent contact, initiated discussion among mentoring program staff about how to help mentoring pairs think of conversation topics. Ultimately, we felt that providing participants with information about issues of professional development could increase their levels of interaction. The emails have an article attached and pose questions that pairs might discuss. We choose articles from a variety of sources to use in these emails. Among the publications we have used are *Science*, *Chronicle of Higher Education*, *Association for Women in Science Magazine* and *Inside Higher Ed*. The emails have touched on issues such as time management, diversity in STEM fields, government careers, and communicating with advisors.

Our final initiative to increase contact with mentoring pairs is new this academic year. On the annual evaluation from last year, a mentor stated that she wanted more support throughout the year. In discussing this, the mentoring program staff realized that participants who missed the orientation or did not read the handbook were, in effect, not receiving any information about effective mentoring. As a result, we began to look more closely at our mentoring training materials and decided to start sending monthly emails with information about mentoring. These emails help remind participants about strategies of maintaining successful mentoring relationships and help others who may not have read through information they have previously received. The topics for this year's emails include expectations in mentoring relationships, resources for graduate students, and diversity in mentoring.

Having regular and consistent communication with mentoring participants allows program staff to quickly learn when participants need help connecting with each other or when a match is not working. It provides mentors and mentees with conversation topics and reminds them to contact their mentor or mentee. We hope that this contact with participants not only strengthens our relationship with them, but also strengthens each pairs' relationship as well.

Events
Several changes have been made to our events over the last few years. The changes have been made to allow the events to form a network mentoring opportunity for all STEM graduate students and to increase the effectiveness of our events. Currently, we offer about one event per

month during the academic year. The events focus on issues of personal and professional development that are not often talked about in other settings. Some of the events are led by speakers from CWD, the Center for Career Services, or the Student Counseling Center. Other events are panel presentations with faculty, postdoc, or graduate student panelists. Events in the last couple of years have focused on topics such as *Families and Academic Careers*, *Stress and Depression in Graduate School*, *Public Speaking Skills*, and *Learning to Ask for What You Need.*

Previously, our events primarily focused on serving the needs of our mentoring participants. In the past couple of years, we began advertising our programs to all graduate students and postdocs in STEM fields. Changing our events programming to open it to all of STEM rather than just program participants brings together a larger audience for a network mentoring experience.

One of the changes that we have made to try to increase the effectiveness of our event programming is to hold the events during a consistent time slot and location. When events were held at various times throughout the week, we could never tell if low attendance was due to the event topic or the time slot. After surveying mentees, we found that Friday afternoons seemed to be a good time. We have also begun holding all of our events in the conference room area adjacent to our office. Having all of the events in a consistent location, helps us to have an identity among graduate students and provide other resources to graduate students through display racks with brochures and articles relevant to STEM graduate students.

Finally, over the past couple of years, we have shifted the focus of our events. Previously, the majority of our events focused on job search issues. Doing this meant: (1) we were often duplicating the efforts of organizations like Career Services and (2) there were few events that were appropriate for newer graduate students. These new workshops include *Public Speaking Skills*, *Forming Your Committee Strategically*, and *Stress and Depression*. These sorts of topics are not often talked about and we pride ourselves on giving students an outlet to consider them.

Handbook Revisions
Most recently, we gave our handbook and other training curriculum a major overhaul. The program had used the *Curriculum for Training Mentors and Mentees in Science and Engineering* (Brainard, Harkus, & St. George 1998). As mentioned above, after a comment from a mentor requesting more support, we began to scrutinize the handbook. We now use a revised edition of the handbook that is more specific to our program and the needs of our participants. Among the changes we made were to: (1) separate the handbook into multiple sections, (2) include a "Resource List" handout, (3) create a "Tips and Tricks" handout, (4) include information about the role of mentoring program staff, and (5) update the section on diversity.

Participants now receive a multi-color packet that includes a Mentoring Handbook and the following handouts: Communicating with your Mentee (or Mentor), Tips and Tricks for Mentors (or Mentees), Mentor and Mentee Agreement, UW Resource List for Graduate Students, Mentor (or Mentee) Expectations Checklist, and Learning about the Mentor.

One of the simplest things that we did to the handbook was to make it easier to read. Previously, mentees and mentors were given a large packet of papers all stapled together. Now, participants are given a folder with a handbook and handouts on separate pages and in different colors rather

than stapled together on paper of one color. We feel this helps to better highlight the different sorts of information in the packet and call attention to particularly useful sections. In addition, this made the handbook itself much shorter, which also makes it easier to read.

For many years, CWD has maintained a list of resources on campus for graduate students. The list was updated semi-regularly and included information about campus groups like the Center for Career Services, and the Graduate Opportunities and Minority Achievement Program as well as off campus resources such as the Association for Women in Science. In the past, this sheet was distributed at events, but never systematically given to mentees and mentors. Including this information in our handbook packets is critical because it helps mentees find other resources on campus might be useful and gives mentors options about places to refer their mentees.

The handbook packet now also includes a "Tips and Tricks" Sheet. This handout was developed to make it easy for mentees and mentors to learn about successful mentoring relationships. The sheet refers participants to the rest of their packet for more information and encourages them to email the program staff with any concerns they might have.

When the *Curriculum* was originally written, it was intended to be used in multiple settings. As a result, it did not include specific information about our program. To remedy this, we added a section about the role of our program staff. By making sure that participants know how we can assist them, we hope to help them feel more comfortable contacting us. The handbook now indicates that the program staff can help participants get in touch with their mentee or mentor or strategize about how to get what she or he needs out of a mentor, among other things.

The *Curriculum* also previously included a section called "Diverse Mentoring Relationships" that mainly focused on cross-gender and cross-race mentoring relationships. Clearly including information about diverse relationships is important, but we felt a need to ensure that this section reflected more current attitudes towards diversity, as times have changed since the *Curriculum* was written. In order to do this, we made two significant changes to the section. The first change was to address issues other than just race and gender. The revised section now talks about the fact that mentees and mentors may differ on many characteristics, including: gender, race, age, sexual orientation, nationality, socioeconomic group, family background, work experience, religion, disability, and experience at community colleges. One of our goals for this revised section is to raise awareness of the multiple aspects of diversity within STEM fields.

The other change to this section was to avoid making generalizations about groups. Previously, the section included statements about how women or individuals of color tend to communicate or react in certain situations. These sorts of statements make generalizations about groups that may not apply to all members of those groups (and may apply to non-members), making them problematic. We changed this section to reflect the variation both between and among groups and better mirror the current literature and attitudes on diversity. Making these changes better reflects the diverse group of individuals in STEM fields and their varied experiences.

Evaluation of Mentoring Program Changes

As the programmatic changes detailed above have taken place, participants have communicated increased satisfaction with our mentoring program. We have gathered feedback about the

program and events through annual evaluations, informal contact with the participants, and by measuring attendance at our events. These methods of information gathering have led us to conclude that the programmatic changes we have made are positive.

Methodology

At the end of every academic year, we administer an annual evaluation to mentees that asks questions about contact between mentors and mentees, as well as questions related to the perceived impact of the program on retention and professional development. It also asks about participants' expectations and experiences with the program and ways that they think the program could be improved. We have examined mentee evaluations from the last three academic years – 2003-2004, 2004-2005 and 2005-2006 – to understand the effects that our programmatic changes have had on our participants. The response rates for the mentee evaluations are 59.1% (39 of 66), 80.0% (52 of 65) and 62.5% (30 of 48), respectively.[1]

Although much of the evaluative results for the program are based on the annual evaluation, we also use informal feedback from participants and measures of attendance at our events. These other forms of evaluation are important, not only because of the valuable feedback they give, but also because we are able to gather this information throughout the academic year. The fact that participants take time out of their busy schedules to give us unsolicited feedback speaks to the strong feelings that are behind these comments.

Overall Success

Our mentoring program has seen continued success since its inception, with participants indicating they are satisfied with their relationships and that they have received benefits from the program. Although we have made the programmatic changes mentioned above in the last few years, these were not developed because the program was failing at its goals. Rather, our constant evaluation of the program has helped point us to ways that we could make the program even better for our participants. For example, in the 2003-2004 annual evaluation, before any changes were made, more than 79% (n = 31) of mentees felt that their mentor match had been a good one – as one mentee wrote, "I would have picked him if it had been up to me!" Continuing the trend, large majorities of students in the last few years have felt that their mentoring match has been a strong one (79%, n = 41, in 2004-2005 and 77%, n = 23, in 2005-2006).

Frequency of Contact

Increasing our contact with participants throughout the year has improved the overall experience for our participants. Since we have increased communication with our participants, we have seen higher retention of mentees and mentors in the mentoring program, more frequent contact within mentoring relationships, and increased overall satisfaction with the mentoring program.

Table 1 shows the rates of students wanting to continue in the mentoring program, a rematch with a different mentor, or withdrawing from the program. At first glance, it might appear that our retention rate has remained relatively constant over the past three years. However, for the 2003-2004 evaluation, five students withdrew from the program without completing the annual evaluation. Taking this into account, the retention rate for 2003-2004 is actually 24 out of 44,

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[1] Between the 2004-2005 and 2005-2006 academic years, our relationship with the Chemistry Department ended. As a result, we had fewer participants in our program in the 2005-2006 academic year.

just above half of all mentees. Increased contact since the 2004-2005 academic year encourages more students and mentors to approach us when their mentoring relationship is not working rather than waiting until the end of the year. The large majority of our students who remain in the program from year to year speak to our program's success.

Table 1: Frequencies of Retention in Mentoring Program

Academic Year	Number of Responding Mentees	Continue in Program		Withdraw from Program		Request Rematch		Graduating /Leaving UW	
		N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
2003-2004	39*	24	61.5%	2	5.1%	4	10.3%	9	23.1%
2004-2005	52	37	71.2%	1	1.9%	2	3.8%	10	19.2%
2005-2006	30	20	66.7%	3	10.0%	2	6.7%	5	16.7%

* The number of responding mentees for 2003-2004 does not include 5 mentees who withdrew from the program and did not submit a completed version of the annual evaluation. Taking these students into account, 24 out of 44 students, or 54.5%, continued in the mentoring program that year.

In addition, we think that our more frequent contact throughout the academic year has helped our mentoring pairs stay in better contact with one another, thus strengthening their relationship. In the past two years, more mentoring pairs are meeting in person and emailing more frequently than they did in 2003-2004. Whereas in 2003-2004 more than a third of all mentees (35.9%) either never or rarely exchanged emails with their mentors, this number has been under one quarter of all mentees (9.6% and 20.0%) in subsequent years. Similarly, in 2003-2004, 38.5% of all mentees never or rarely met in person with their mentors, but this number was 12.2% in 2004-2005 and 13.3% in 2005-2006.

In the 2003-2004 annual evaluation, 46.2% of mentees noted that incompatible schedules were often a barrier to their relationships; others noted that they felt nervous approaching their mentor without "a specific problem of some sort." More than half of these mentees noted that their mentoring relationship would have benefited from more interaction (51.3%). In comparison, large majorities of mentees from the next two years answered in the annual evaluation that their personal access to their mentor was appropriate for their mentoring needs (94.2% and 89.7%, respective to the evaluation years). Our increased interaction with mentoring pairs over the academic year gives them more reminders and opportunities to communicate.

We asked on the 2005-2006 annual evaluation whether mentees read our programmatic emails. Almost everyone responded that they read them at least occasionally (93.3%).   One student commented that these informational emails are particularly useful because "We don't get a lot of 'meta-information' about the graduate school experience in my department, and it's nice to hear about broader issues and implications of being a student." In addition, mentoring program staff occasionally receives emails from mentees and mentors who feel that a particular article is especially relevant for them. We believe that mentoring pairs will respond similarly to our mentoring emails. However, as they are a very new component of our mentoring program, we will not have any evaluative data on them until our 2006-2007 evaluation this spring.

Events
In the past few years, we have changed the focus of the events, altered the event structure, and expanded who we invite. We can evaluate these changes by looking at annual evaluation data and patterns of attendance at our events. In the 2003-2004 annual evaluation, we asked mentees what prevented them from attending events. The majority stated that they were too busy (79.5%, $n = 31$) and many said the events were at inconvenient times (41.0%, $n = 16$). During the 2003-2004 academic year, participation at our events was low and inconsistent, with as many as thirty-seven or as few as six people in attendance. Although our ten mentoring program events had an average of 12 attendees, 5 events had fewer than 10 attendees. Spurred on by the evaluation results above, we changed the annual evaluation to include a question about the preferred time for events and concluded Friday afternoons would be a good time. Since standardizing the time slot for our event programming, attendance at our events has increased and been more consistent. During the 2004-2005 academic year, between 4 and 35 students attended the 7 offered events, averaging 16 students per event. During the 2005-2006 academic year, between 14 and 29 students attended the 5 offered events, with an average attendance of 17 students.

Before we started advertising to a wider audience, participants at events were primarily from our program, but now a majority of event participants are not mentees in our program – on average, more than 87% of event participants during 2005-2006 were from outside the mentoring program. We feel that having a wider audience of students at our events contributes to a network mentoring effort, with students interacting and sharing their experiences and lessons learned.

Handbook Revisions
The mentoring handbook revisions have only been in place for a few months, but we have already received enthusiastic comments from mentoring participants about them. For example, one mentor wanted her home department to use them for their internal mentoring and advising. One mentee expressed appreciation that we had sent him a new mentoring handbook, saying that it made him feel more connected with the program. We will ask mentees and mentors more systematically on the annual evaluation about the revised mentoring handbook.

Recommendations
Based on our experiences with making changes to our mentoring program, we would like to offer the following recommendations for other such programs.
1. Periodically, assess your program to determine if it is meeting your participants' needs.
2. Listen to your program participants about improvements they would like to see.
3. Make it easy to participate in your program.
4. Make your program multi-faceted to appeal to individuals' preferences.
5. Periodically review your materials.
6. Stay in close contact with your participants.
7. Although mentors are a great source of information on personal and professional development, provide mentees with other information on these topics.

Conclusion
The literature on STEM graduate students indicates the importance of mentoring for successful careers. Because of this, our program thrives, and we have made changes to our program in order to provide graduate students in STEM fields with positive mentoring experiences that fit

their changing needs. We were particularly concerned with helping mentees have regular interactions with their mentors, helping participants fit mentoring into their already busy lives, and enriching our programming with additional information on professional development.

At times, mentees need help maintaining their relationship with their mentors. This may be because they feel shy about approaching their mentors or are unsure of what to talk to their mentors about. By having regular contact with participants, we have been able to combat this issue. Not only do our emails remind mentees and mentors about their participation in our program, they give them information about issues relevant to STEM graduate students or provide them with information about effective mentoring relationships. In addition to the emails, we hope that the revisions to our handbook have also helped mentees maintain their relationships by providing them with accessible information about ways to develop good mentoring relationships.

In recent years, we often heard from both mentees and mentors that they had difficulty making time to participate in our mentoring program. As a result, we have tried to make the program easier to participate in. Many of the revisions to the handbook, for example, were designed to make it easier to use. Not only is the information presented in a more concise manner than it was before, but it is also easier to find information within the handbook materials. Finally, we also see our semi-monthly emails and mentor training emails as changes that help mentees and mentors find time to participate in the program. These brief emails do not take long to read and provide mentees and mentors alike with important information.

Changes to our programming, including our semi-monthly emails, enrich our participants' mentoring relationships by providing them with professional development information they might not otherwise receive from their mentors or other sources. Additionally, we have tried to make sure that our events and workshops focus on issues that graduate students may not get information on from their mentor or in other settings.

In addition, through our changes to our mentoring program, we have been able to reach out to students who for whatever reason do not participate in a one-on-one mentoring relationship. All graduate students and postdocs are invited to our monthly events. In addition, graduate students are invited to sign up to be on our email list. Students who choose to do this receive the same programmatic emails sent to all of our mentees. Doing both of these activities allows us to provide network-mentoring opportunities to a group of graduate students wider than just our mentoring participants.

After evaluating the changes we have made to our program, we feel that our program overall has been significantly strengthened and we are proud of the experiences that we are able to provide to our participants. This is not to say, by any means, that the process of evaluating and changing our program is complete. We will continue not only to evaluate and assess the changes that we have made to date, but also try to identify other areas where we can improve our current offerings. Continually engaging in this process allows us to be certain that we are continuing to provide an excellent program to our participants.

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