Mentoring Workshops to Support Women Research Students in Science and Engineering

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Abstract

Although there are currently many mentoring programs available for women in science and engineering, few of these programs directly address the mentor-mentee relationship between a student and her advisor. However, this relationship is a crucial factor for research success and degree completion. In this paper we describe a Mentoring Workshop program developed at the University of Cincinnati which concentrates on improving the mentoring aspects of this important relationship. The Workshops are based on mentoring materials developed by WEPAN (Women in Engineering Programs and Advocates Network) and have been used to improve mentor-mentee skills for women graduate students and their advisors, as well as for students in the University's Research Experiences for Women Undergraduates summer program. Workshop facilitators are drawn from faculty members of the University's Women in Science and Engineering (WISE) Committee. The Workshops make effective use of the valuable resource of faculty time contributed by the facilitators, and also expose the women participants to women faculty who have succeeded in science and engineering and who might provide additional mentoring in the future. The Workshop format allows for interaction and discussion among the entire group, as well as among smaller subgroups, and thus facilitates interchanges of perceptions about mentoring and reinforcement of good mentoring practices for all attendees. Workshop evaluations indicate that both faculty and student participants are enthusiastic about this program.

1. Introduction

Mentoring relationships have the potential to help women engineering students master specific skills (e.g., giving talks, writing proposals, writing dissertations / theses, managing one’s career, supervising and mentoring students, running a lab); explore career choices; obtain a different perspective on research problems; and learn how to cope with stress, manage time, and meet family and work responsibilities. A mentor can also be a role model to encourage the student to complete her degree, and can provide valuable information on how to establish oneself professionally. Because of the unique research advisor / student relationship and the isolation in a
particular laboratory group, students doing research at either the undergraduate or the graduate level and their advisors can benefit from specific training in the mentoring aspects of this relationship. The Mentoring Workshop project we describe here has been developed by the Women in Science and Engineering (WISE) Committee at the University of Cincinnati, a volunteer faculty committee which was created in 1996. The Workshop was first developed to supplement the WISE Summer Research Experience for Women Undergraduates (REWU), which is in its fourth successful year of supporting undergraduate women in summer research projects. It has also been offered to groups of women graduate students and their advisors. Based on the Women in Engineering Programs and Advocates Network (WEPAN)\textsuperscript{1} Mentor Training Curriculum\textsuperscript{2}, the Workshop can be offered with only a modest amount of preparation and thus can easily be sustained. It can also be customized for various audiences. Goals of the Workshop are: to improve directly the research experience of both undergraduate and graduate students, to give faculty research advisors a forum to discuss mentoring practices, and to learn "best practices" from one another.

The WISE Committee offers this Workshop once a year to the summer REWU students. In 2001-2002, the Workshop was also offered to graduate students and their advisors who were recruited from research groups containing WISE Committee members. This recruitment method allowed the Committee to determine that graduate students and their advisors found value in the Workshop. However, it was clear that a more formal recruitment method was needed at the graduate level and that an effective strategy would be to coordinate the Workshop with ongoing enrichment activities for graduate students. Thus, in 2002-2003, the Committee has scheduled two Workshop sessions for graduate students and their advisors, one for those students participating in university and departmental Preparing Future Faculty programs, and one which is included in the Graduate Student Workshop Series organized by the University's Office of Research and Advanced Studies. Assessment indicates that participants, both faculty and students, are uniformly enthusiastic about the Workshop. Current goals for the program include making the Workshop available to more graduate students and offering follow-up "refresher" Workshops to previous participants.

2. A Survey of Mentoring Programs

Currently there are many initiatives to provide mentoring to women students in science and engineering. These include, for example,

- organizations such as WEPAN\textsuperscript{1}, the Association for Women in Mathematics\textsuperscript{3}, the Computing Research Association’s Committee W (CRA-W)\textsuperscript{4}, and SYSTERS\textsuperscript{5}, which provide information on the web and through publications, sponsor Workshops on career development, conferences, and training courses, collect statistics, and maintain electronic mailing lists. Many professional organizations, including the American Society for Engineering Education, the Institute for Electrical and Electronics Engineers, the Association for Computing Machinery, the American Physiological Society, the American Society of Mechanical Engineers, the American Chemical Society, and the American Physics Society, also have started initiatives directed at improving the environment for women in their respective professions. The American Association for University Women (AAUW)\textsuperscript{6} also sponsors a fellowship program to support graduate work in science and
engineering fields;

- programs at individual institutions which provide activities and contact with faculty members. Often these programs are part of larger institutional initiatives which also include similar undergraduate programs, along with mentoring for women faculty. Some notable initiatives at the graduate level have been established, for example, at the University of California at Berkeley’s Electrical Engineering and Computer Science Department, Carnegie-Mellon University, the University of Michigan, Purdue University, and the University of Washington. Seminar series for graduate women also exist, for example, at Purdue and at Ohio State University. Comprehensive guidelines for setting up these types of programs, at both the undergraduate and graduate level, are available;

- programs developed and run by students themselves, such as the "Noetherian Ring" at Berkeley and its descendants at several other universities and "learning communities" such as the one described by Washburn;

- web-based mentoring programs, such as MentorNet, which matches undergraduate and graduate women in science and engineering with established scientists and engineers; and the new Faculty for the Future initiative;

- books such as the comprehensive discussion of Ph.D. study by Lazarus, Ritter, and Ambrose;

- programs supported by industry, including the AT&T Fellows Program.

All of these programs provide important support and information in various ways and many provide mentors to help overcome many of the obstacles listed above. But none of these programs specifically addresses the student’s relationship with her research advisor. The Mentor Training Workshops we describe here are specifically designed to strengthen the mentoring aspect of this important relationship.

3. Concerns Which May Be Addressed Through Mentoring

Some factors which may negatively impact the progress of any research student in science and engineering include

- change of focus from class-based work to research, with its much less structured format and associated requirements for independence on the part of the student;

- lack of information and advice, including, for example:
  - lack of information about how to choose a graduate program;
  - lack of guidance in choosing an advisor;
  - lack of information about how to prepare adequately for comprehensive exams;
  - lack of training in necessary skills such as giving a presentation or writing a grant proposal;
  - lack of career guidance;
  - lack of feedback on progress towards the degree;

- poor or nonexistent management of graduate students, including, for example:
  - lack of procedures for changing advisors if the relationship becomes problematic;
  - isolation in a small or badly run research group;
  - lack of managerial skills on the part of research advisors;
  - lack of oversight of faculty supervisors and of administration support for programs that would improve the quality of graduate student life;
unclear and often unreasonably long timelines to degree completion;

- external factors, such as:
  - outside demands from research sponsors;
  - budget constraints which lead to low stipends and uncertainty about continuing financial support;

- and interpersonal issues, such as:
  - differing standards among research advisors in the same department;
  - advisors' own unpleasant graduate experiences, which they may have come to view as necessary to their success;
  - competitiveness or hostility among research group peers;

while some of the factors which may be especially relevant for women12 include

- the traditional view of science and engineering as a “monastic” discipline with the accompanying need for complete dedication to research, which may be difficult or impossible for women with heavy family responsibilities to sustain;
- the need to juggle work and family responsibilities and the health benefits of having a balanced life, which women are more likely to be aware of than men;
- faculty disdain for part-time students or for students who do not have a continuous career history, categories into which women are more likely to fall than men;
- nonexistent or ineffectual policies on sexual harassment;
- differences in traditional working styles between men and women;
- differences in how men and women communicate their ideas;
- lack of female role models in supervisory roles;
- faculty who are dismissive of women, either overtly or implicitly.

If we examine this list, we see that, while some of the obstacles to success in research, such as outside demands from research sponsors and budget constraints, are systemic, many more, such as lack of career guidance and isolation in a badly run research group, could be overcome or at least minimized by improving both the mentoring skills of the research advisor and also the student's ability to be mentored successfully. And, as has been the case for other initiatives, many of the activities that would improve the research experience for women students would also improve it for all students.

4. The UC WISE Mentoring Workshops

The University of Cincinnati (UC) is a comprehensive Research-I or research extensive institution, with approximately 32,000 students from primarily urban backgrounds, in an ethnically diverse city. At the undergraduate level, UC attracts mostly local students, largely working and middle class, with a significant non-traditional student component. Overall, about half of the 20,000 undergraduates are women. In the College of Engineering, in Fall 2002, 17.1% of undergraduate students and 19.9 % of graduate students were women. These women are not evenly distributed across departments. For example, in Electrical & Computer Engineering and Computer Science, in recent years, about 6% of the undergraduate students have been women, while in Chemical Engineering, the percentage of women is typically 20-24%. At the graduate level, in science and engineering especially, there is a large proportion of international students, as is the case in most large state universities at this time. Domestic graduate students in science and engineering are
often recruited from the undergraduate student body, many of whom are the first in their family to
attend college, and many of whom attempt to combine full-time employment with graduate work.
Graduate programs in science and engineering can be found in the College of Arts and Sciences
and the College of Engineering on the “West Campus” and also in the Medical School on the
“East Campus”. Overall, there is no significant contact between West Campus and East Campus
faculty. There is no permanently funded university-wide program to support women students or
faculty in science and engineering, although recently such a program, focusing mainly on
recruitment and retention of undergraduate women, has been established in the College of
Engineering.

Because it is essentially a volunteer faculty group with limited time and resources, UC's WISE
Committee originally focused only on undergraduate programs. Its main program is the Research
Experiences for Women Undergraduates (REWU) summer program, now in its fourth year.
REWU is designed to provide participants with a significant research experience and to encourage
them to consider going on to graduate school. REWU places 15-20 undergraduate UC women in
labs each summer. Both students and potential mentors must apply to be part of the program,
although for mentors the application consists mostly of submitting a short description for a project
which an undergraduate could reasonably accomplish within the program's 10-week timeframe.
An important feature of the UC WISE REWU program is the broad diversity of technical
expertise of the participants. Advisors come from any one of six science or six engineering
departments, as well as from UC's Medical School, which has very few undergraduate programs.
Thus the advisors' backgrounds are extremely varied.

Each student in the REWU program is matched with a specific faculty research advisor and must
give a formal presentation and written report of the summer research project at the end of the
program. Students must also attend a weekly seminar where they interact with one another and
with their faculty advisors and learn about topics such as how to read a scientific paper, how to
give a scientific talk, and how to investigate opportunities for graduate study. For most of these
students, the REWU program is the first experience of doing research and fitting into the
organizational environment of a laboratory, and this sometimes has a negative impact on their
overall experience. In addition, research advisors occasionally misjudge the undergraduates'
abilities, giving them either too much or too little responsibility. To lessen these difficulties, in the
summer of 2001 a Mentoring Workshop, based on the WEPAN Mentor Training Curriculum was
added to the REWU program. This Workshop is now also offered periodically to women
graduate students and their research advisors as an aid to developing the mentor / mentee aspects
of their relationship.

Clearly, if we use the description of "mentor" given in the first paragraph of the Introduction, then
"mentor" and "faculty research advisor" are not equivalent, although some of the faculty
participants in our Mentoring Workshop, at least initially, do use these terms interchangeably.
Certainly an advisor can be a mentor according to this description, but there is no guarantee that
an advisor will serve in this function, and certainly a mentor need not be an advisor or even a
faculty member. In fact, mentoring by multiple mentors is usually desirable. Mentoring skills can
be learned or improved, if the willingness to be a supportive mentor is present. Effective
mentoring, similar to effective teaching, does not conform to a specific style, but good mentors
may share some common traits, such as the ability to listen well, the desire to be a role model for some facet of students' development, and an interest in helping students to become more skilled and independent in particular areas. The distinctions between mentoring and advising are discussed more completely in the Training Curriculum manual\textsuperscript{2}, pp. 92-95. Raising awareness of these distinctions and giving both faculty and students the impetus to think both about what a good mentoring experience is like and about the responsibilities not only of the mentor but also of the mentee are basic goals of our Workshop program.

While the Workshops are focused on mentoring for research, they also promote the idea of seeking out multiple mentors and improving the students' own mentoring skills. They are also low key and designed to be nonthreatening to advisors. Discussion is steered and focused by the facilitators, but the interactive format of the Workshops gives the participants the opportunity to teach themselves and each other how to improve mentoring and mentee skills.

5. Workshop Format and Materials

The Training Curriculum materials\textsuperscript{2} used in the Workshop are targeted mainly towards mentoring for undergraduate students by engineers working in industry, but the Curriculum is very complete and flexible, and it does include some specific materials for research advisor / student mentoring. We have found that a Workshop schedule of 2-3 hours works well, with a break after about one hour for refreshments. During the first hour, both mentors and mentees are present. During the break, mentors fill out evaluation forms. The remainder of the Workshop is for the mentees alone. Two WISE faculty members serve as facilitators, and a faculty member who is not on the WISE committee collects survey forms from both mentors and mentees and provides a summary evaluation. The format is informal, encouraging active participation from all participants. Each participant receives a notebook containing excerpts from the Training Curriculum\textsuperscript{2} to use during the Workshop and also to use as reference material after the Workshop is over. A typical schedule for one of the Workshops is given in Figure 1. Note that the Workshop format is very dynamic and includes discussions by the whole group, discussions in smaller groups, and role-playing. A summary of the discussions, as recorded in the June 2001 Workshop, is given in Figures 2 and 3. (In this Workshop, the issue of cross-gender mentoring was discussed, and the women students gave their opinions only on the advantages of having a male mentor, as can be seen in Figure 3. Typically, the advantages of having a female mentor would also be discussed). As can be seen from the comments in Figures 2 and 3, the Workshops do provide a vehicle to address many of the issues affecting recruitment and retention of graduate students, both male and female. Faculty mentors are invited to participate in the Workshop either because they are already associated with an ongoing program, such as Preparing Future Faculty or the REWU program, or because they have been invited directly by the WISE Committee. During the Workshop, facilitators introduce topics of discussion, and faculty and student peers also provide their viewpoints. Thus the Workshops provide a non-threatening forum for these issues to be addressed and an efficient way for more effective mentoring techniques to be introduced to both faculty and student participants.
6. Workshop Assessment and Further Development

Although not enough assessment data has so far been gathered for a formal statistical analysis, the survey results to date show a high degree of satisfaction with the Workshops, with all participants agreeing that the Workshop was "effective" or "very effective". So far, only minor changes in format and topic order have been necessary to respond to concerns raised by the assessment survey data. At this point there are four major open questions about the Workshop project:

1. Will the Workshops engender real change in the UC science and engineering community?

2. How can the Workshops, which participants rate as valuable, reach greater numbers of students and their advisors?

3. What follow-up activities will most efficiently help mentors and mentees continue to improve their skills in this area?

4. Can the Workshop project be expanded to reach other underrepresented groups of research students and could a similar type of Workshop be used as part of a proposed WISE program for mentoring faculty women in science and engineering?

The WISE Committee hopes to study these issues further in the coming academic year.

Assuming that further assessment confirms the value of the Workshops, the question of how to institutionalize them must also be addressed. This is beyond the current resources of the WISE Committee. The resources needed to sustain the program are in fact minimal. Committee members can continue to serve as facilitators, taking turns so that this task is not overly burdensome, and new facilitators can eventually be recruited from among Workshop participants. The actual mechanics of setting up a Workshop are also not great, but an administrative assistant is needed to ensure that this task is completed on schedule. The most difficult task, ensuring a good level of faculty participation, requires concerted effort and attention, as well as encouragement, from deans and department heads.
Figure 1. Mentoring Workshop--Typical Schedule.

PART A: MENTORS AND MENTEES TOGETHER

1. Introduction (+ breakfast if morning Workshop) 10-15 minutes
   --participants introduce themselves
   --WEPAN Mentoring Curriculum described
   --expectations for Workshop explained

2. Discussion--mentors / mentees separate 15 minutes
   --who has been a mentor?
   --what is mentoring? / what is a mentor?
   --what would you like to get from mentoring relationship?

3. Whole group discusses results of (2) 10 minutes
   --summary; what differences are there between groups' responses?

4. Responsibilities & expectations--mentors / mentees separate 20 minutes
   --facilitators provide suggestions to get discussion started, e.g.,
     objectives, duration of relationship, frequency of contact

5. Whole group discusses results of (4) 10 minutes

6. Break (+ snack) 5-10 minutes
   --mentors fill in assessment survey before leaving

PART B: MENTEES ONLY

7. First contact 15-20 minutes
   --discussion of how not to be intimidated

8. The first meeting--role playing 15-20 minutes
   --mentees pair off; each pair summarizes their experience

9. Navigating the relationship; potential problems 30 minutes
   --problems that may arise
   --advantages of a male mentor
   --strategies for mentees
   --what is most important in the relationship?

10. Summary of Workshop, participants' comments 5-10 minutes
    --mentees fill in assessment survey before leaving
Figure 2. Summary of Workshop Discussions—June 2001.
Discussion with Mentors / Mentees Together.

WHAT IS A MENTOR?
1. give advice
2. emulate
3. role model
4. trusted advisor
5. guide you
6. academic & personal
7. give focus & insight
8. listener
9. freedom to mess up and help fix them
10. emotional support
11. teacher
12. varies over time

MENTEE’S EXPECTATIONS
1. want schedule & structure
2. clear goals--what does mentor expect
3. lasting relationship
4. move student→collaborator maturity
5. opportunity to work with motivated person
6. professional development of mentee
   --learn strength & weakness
7. learning in both directions
8. thinking in terms of “we” instead of “I”
9. trust of mentor & get responsibility
10. instill love or loathing of research
11. freedom to choose

MENTEE RESPONSIBILITIES
1. open, honest with mentor
2. communicate
3. ask when you don’t understand
4. recognize faculty responsibility outside of lab
5. become more self reliant & confident over time
6. don’t be afraid to ask for guidance
7. don’t be afraid of mentor
8. don’t lose time because you need guidance and are afraid to ask

MENTOR RESPONSIBILITIES
1. well-designed, accomplishable goals
2. learning throughout
3. positive experience
4. flexibility
5. how are we doing?
6. no undue pressure
7. maintain professional lab atmosphere
8. personal differences
9. communication 2-way
ADVANTAGES OF MALE MENTOR
1. men have more access—“old boys” club
2. men are more assertive (less sensitive)
3. you may as well get used to working with them—there are more of them
4. may push you harder because he knows you are a minority
5. males more professional
6. males more clear-cut; precise
7. offer different perspective
8. men with kids are more understanding

STRATEGIES FOR MENTEES
1. get involved
2. meet people
3. act confident
4. communicate needs & expectations at beginning
5. establish boundaries early
6. be polite & respectful
7. don’t be defensive
8. developing confidence & independence in project
9. team relationship: “we” accountability
10. specify goals of project
11. approachable mentors
12. flexibility in research paths
13. knowing that confidentiality can be expected in the relationship

THE MOST IMPORTANT THINGS IN A MENTOR / MENTEE RELATIONSHIP
1. communication—confidence
2. evolving relationship; even after the program
3. honesty & openness in relationship
4. specificity of expectations
5. patience with learning styles
6. professionalism (development of)
7. guided relationship
Bibliography

3. Association for Women in Mathematics website, (AWM), http://www.awm-math.org/, accessed 1/14/03.
5. SYSTERS. http://www.systers.org/, accessed 1/14/03.
8. Noetherian Ring, Mathematics Department, University of California at Berkeley, http://math.berkeley.edu/~nr/ing/, accessed 1/14/03.
11. Faculty for the Future website, Facultyforthe Future.org, accessed 1/14/03.

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