

Benefits for Women Students from Industrial E-Mentoring

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MentorNet

Abstract

Mentoring has been hailed as a strategy to improve retention of women students in engineering and related sciences. Electronic communications now can support a cost-effective opportunity for mentoring which transcends previous constraints to mentoring programs – time, synchronous communication, and geography.

MentorNet pairs undergraduate and graduate women studying engineering and related sciences with volunteers in industry for year-long, structured mentoring relationships conducted via e-mail. This large-scale, multi-campus program offers on-line applications, matching, training, and on-going coaching for participants, and evaluation. Increasing student participation from just over 200 to 2,000 over 3-1/2 years leads to a rich database for evaluation. These 2,000 students attend 71 different institutions of higher education, including community colleges.

MentorNet is unique among large-scale e-mentoring programs in conducting extensive evaluation to determine retention, long-term benefits to the participants, and outcomes associated with the e-mentoring process. This paper will describe the program and its evaluation findings, with a particular focus on the results of a survey of student participants one year after they completed their participation in MentorNet. Of respondents to the survey, 95% persisted in their fields, either as they continued in their studies or moved into the labor market. A large percentage of students (81%) had an internship while they were in school; some students reported that MentorNet participation helped them get their internship. In addition, 43% reported participation in MentorNet boosted their confidence. This is a significant finding as the decrease in confidence and lower confidence of women versus men students have been identified as contributing factors to the underrepresentation of women in the engineering, science, and math fields.

Introduction

To address the longstanding problem of under-representation of women in engineering and related sciences, mentoring has been touted as a particularly effective component of any strategies to encourage women's persistence in these fields. Mentoring programs in wide variety have been instituted at colleges across the country, and materials, training programs, and papers have been developed to help support these efforts.^{1,2,3,9,15} The working assumption is that students benefit from having those with greater experience help acquaint them with the opportunities in these fields, offer guidance and advice based on experience, and provide support, encouragement, and access to professional networks for further career development. Effective mentoring offers personal, one-on-one attention, and may also provide insight about

tacit knowledge, the often unspoken cultural and structural elements of an academic field, profession, or work environment.

Both anecdotal evidence and more structured evaluations of mentoring experiences for women students in engineering and related sciences suggest that mentoring has had a positive effect on their likelihood of persistence in studying and entering careers in these fields.^{1,2,4,5,6} Yet effective structured face-to-face mentoring programs only reach a small portion of women students who might benefit from them. To address this problem, a nationwide mentoring program was created in 1997, designed to leverage electronic communications for mentoring, so as to involve students and mentors previously unable to participate in such programs due to constraints of time and/or location, and to create a more cost-effective infrastructure to serve large numbers of student-mentor pairs.^{10,11,12,13} MentorNet^{SM16} was initially founded by the first author as a program of the national nonprofit Women in Engineering Programs & Advocates Network (WEPAN), and in 2000, incorporated as a separate nonprofit organization; MentorNet is headquartered at the College of Engineering at San José State University, with additional offices at De Anza College in Cupertino, California, and in Burlington, Vermont. The national program was launched with a pilot semester in early 1998, serving just over 200 students from 15 colleges and universities; in 2000-01, MentorNet served 2,000 students from 70 different campuses in the U.S. and Canada, and expects to continue to increase numbers served in the future.

TABLE I
MENTORNET GROWTH

	Year 1 1998	Year 2 1998- 99	Year 3 1999- 2000	Year 4 2000- 01	Year 5 2001- 02	Year 6 2003- 04
Students Matched	204	515	1250	2000	3500	5000
Mentors Matched	204	515	1214	1913	3500	5000
Participating Campuses	15	26	36	71	100	125
	Actual				Projected	

While long-term effects cannot readily be documented for several more years, given MentorNet's relative youth, we have evaluated the program across several dimensions. In particular, we wanted to test the value of using electronic communications for mentoring, to collect data that would enable us to improve the program, and to determine retention effects, longer-term benefits to the participants, and outcomes associated with the e-mentoring process.

Program Description

MentorNet focuses on industrial electronic mentoring (e-mentoring), complementing academic mentoring that may occur in face-to-face relationships on campuses. Student participants – the protégés – are women studying in engineering, science, and math fields at any postsecondary level (first year undergraduate or community college through postdoctoral students), who are considering scientific or technical careers in industry, and who are currently enrolled in one of

MentorNet's participating campuses. Their mentors are professionals working in industry or government, women and men, trained in scientific and technical fields. Students and mentors engage in a mentoring relationship conducted via email over the course of one academic year at a time.

MentorNet represents a partnership among colleges and universities, corporations, professional societies, and government sites and agencies. In addition to mentors, other active volunteers working to support MentorNet include the designated program representatives in colleges and universities, corporations, professional societies, and in government labs or agencies. These representatives identify and recruit participants, certify eligibility, provide information about their organization, determine any relevant organizational policies and practices related to supporting participation in the program, participate in evaluation, and are available to solve problems at the level of the participating organization. These individuals often make the initial contact with eligible students or mentors, and augment MentorNet staff efforts to recruit mentors.

Once alerted to the opportunity, prospective students and mentors visit MentorNet's web site¹⁶ where they find on-line information and applications. After reviewing these materials, they may sign up as participants during the open recruiting period, beginning in mid-summer and continuing through approximately the end of October. The information on their applications, which details both their own backgrounds and their preferences in being matched by area of technical interest and major field of study, industrial sector, gender, and other issues of particular interest, is automatically entered into a database. Sorting software developed by MentorNet identifies the most suitable potential mentors for a student.¹⁴ As tentative matches are made, program staff members review the matches, as well as information provided in open-ended queries on the application, to ensure the matches are reasonably strong.

In addition to providing the application and matching structure, MentorNet's program staff facilitates introductions, and provides training and coaching throughout the year. Established expectations include approximately weekly communications between mentors and students. Training materials are posted on the MentorNet web site. The *Guide for Mentors*¹⁷ and the *Guide for Students*¹⁸ offer suggestions for developing successful mentoring relationships. Sections within these guides address widely accepted "netiquette" rules, emoticons, and acronyms, obstacles underrepresented students face in engineering and related scientific fields, and issues of cross-gender and cross-cultural mentoring. Another section explains ways in which electronic communication differs from face-to-face communication and provides advice on how to communicate via e-mail. Participants are encouraged to familiarize themselves with these materials at the onset of the program. Throughout the program, reference and links to the training materials encourage additional familiarization with the content. During the academic year-long e-mentoring relationships, the MentorNet staff provides on-going coaching, support, and information to the students and mentors as they introduce themselves to one another, become acquainted and establish goals for their mentoring relationship.

MentorNet's network of partnering organizations and corresponding volunteers, reliance on electronic communications, and large scale support an organization which can achieve economies of scale and continue to grow. The large scale makes feasible the development of

adapted software and systems to support electronic communications for large numbers of participants, and as a result, MentorNet program facilitators can serve many more mentoring pairs than ordinarily could be supported in a traditional structured mentoring program.

Evaluation Methods

It is important, given the resources invested in creating and sustaining large-scale electronic mentoring programs, to evaluate their effectiveness, not just in a few select cases, but across all participants. Central to MentorNet's growth and program development are evaluations, and these have been conducted in collaboration with two external evaluation firms, Ithaca Evaluation Group (IEG) and Quality Evaluation Designs (QED). With IEG, MentorNet has undertaken regular formative evaluation, with some preliminary summative components.⁷ Beginning in 2000, working with QED, we began a five-year study to consider longer term effects of the MentorNet experience on students.⁸ In each case, we have collected data from participants via web-based questionnaires.

With both formative and summative components, but emphasizing the former, IEG invited all participants to complete year-end questionnaires in each of the first three years of the program, and also undertook an unobtrusive (but consented) monitoring of all email traffic among a random sample of 20 pairs of participants in 1998-99, with an analysis of frequency, timing (e.g., lags between queries and responses), and content. Beginning with the 1999-2000 program year, while all participants were invited to complete the web-based survey, reminders and analysis focused on a random sample of 200 pairs of students and mentors. Analysis included generation of baseline statistics, assessment of factors related to satisfaction with mentor-protégé matches, and consideration of outcome measures for differences related to other variables.

In the spring of 2000, in the first year of a five-year, long-term evaluation of the MentorNet program, QED emailed student participants from the previous program year (1998-99) and requested their completion of a web-based survey to learn more about longer term effects of participation in MentorNet. This evaluation was designed to address persistent questions about what happens to student participants in the years after they participate in the program, and the preliminary results now available will be amplified considerably in later years, as the numbers of participants surveyed grows (because of the increasing numbers of students in subsequent program years) and as more students complete their studies. The evaluation focused particularly on three general questions, designed in response to interviews with program stakeholders, principally representatives of organizations providing funding and volunteers in support of the program. The three questions were: 1. Does involvement in MentorNet promote the retention of women in math, science, and engineering-related majors and careers? 2. Do 1998-99 protégés believe that MentorNet is worthwhile? And 3. Does MentorNet sponsorship increase the perception that sponsoring companies and academic institutions are "women-friendly"?

Results from these evaluations begin to inform questions about the outcomes of MentorNet participation for students. Because the QED evaluation was designed specifically to address these questions, we focus particularly on the preliminary results of that study, and also include data related to longer-term outcomes from the most recent IEG evaluation.

Results

Of the email messages sent by QED evaluators to the 515 student participants one year after their participation in 1998-99 MentorNet, asking them to complete the web-based survey, 69 were returned with “permanent fatal errors,” highlighting one of the challenges of collecting data based on email addresses which often are transient, particularly as students move from campus into the labor force. Beginning with the 1999-2000 cohort, MentorNet has collected additional information to assist later tracking, including alternate email addresses, and permanent home addresses and telephone numbers; these data were not available for the 1998-99 cohort. Three reminders were sent to the remainder of the group, yielding responses from 121 proteges, for an overall response rate of 27%. Due to this response rate, we are interpreting these results cautiously and are viewing them as preliminary results that will be tested with future evaluations. QED email and telephone follow-up with all nonrespondents yielded response to a very abbreviated survey from an additional 44 individuals, finding no significant differences between this group of initial nonrespondents and the earlier respondents. The numbers, however, are small, and this non-response bias survey did not focus on 100% response from a representative sample, so we are not in a position to determine to what extent the respondents characterize the participants as a whole.

Queries related to the question, “Does involvement in MentorNet promote the retention of women in math, science, and engineering-related majors and careers?” show high levels of confidence and retention. Of respondents to the QED survey, one year after participation in MentorNet, 95% have remained in math, science, and engineering (MSE) majors and careers, including 68% continuing as students in MSE fields, 18% going on to employment in industry, and 9% going on to graduate school. Of the 81% (n=98) of respondents indicating they had worked in internships at some point during their higher education experience, 6 students reported that MentorNet participation had influenced their internship. 43% agreed or strongly agreed that MentorNet participation boosted their confidence. One-third agreed or strongly agreed that MentorNet participation encouraged them to complete their academic degree. Nearly 70% of respondents agreed or strongly agreed that MentorNet was a good use of their time, 20% were neutral, and 12% disagreed or strongly disagreed. Protégés with female mentors were more like to agree or strongly agree that MentorNet was a good use of their time (although year-end evaluations of MentorNet experiences consistently have shown no difference in satisfaction between having a female or male mentor).

In considering the question, “Do 1998-99 protégés believe that MentorNet is worthwhile?,” protégés overall reported that their participation in MentorNet both supports and promotes their academic and career success. 68% reported positive relationships with their mentors, 18% were neutral, and 15% reported negative relationships. While only 18% of respondents who were still students applied for a MentorNet mentor the second year, 31% were still in communication with their mentors without formal participation in the program. Of those no longer in academic programs, 62% continued to communicate with their mentors. As a result, 50% of the respondents overall either continued to communicate with their mentor or applied for a new mentor within the program. Responses also indicated that mentor rapport was a significant factor in influencing whether protégés would seek mentors in the future. Protégés who were dissatisfied with their mentor suggested several factors which might contribute to dissatisfaction:

mentors who were too busy to respond to email, or responded too briefly; or a perceived mismatch of fields or degree level aspirations (e.g. a masters student interested in pursuing a Ph.D. matched with mentor with a terminal masters degree). Those who neither continued contact with their mentor nor applied for a new mentor through the MentorNet program fell into three categories: those who found mentors elsewhere, those who had poor experiences with MentorNet, and those who felt they lacked time for a mentoring relationship. Finally, 46% of all respondents agreed or strongly agreed that MentorNet improved their ability to network, and 26% agreed that MentorNet enhanced their ability to secure post-graduate employment.

In examining the question, “Does MentorNet sponsorship increase the perception that sponsoring companies and academic institutions are ‘women-friendly’?,” the response was less conclusive. There is some evidence that sponsoring organizations may benefit from positive attitudes from student participants, but the data so far are very limited, and will require further exploration in future years. Respondents were asked their perceptions of “women-friendliness” of their academic institution and of sponsoring and comparable non-sponsoring companies. Among both those who had and who had not graduated from their academic programs, 72% rated their academic institution as friendly or very friendly, about 12% were neutral, approximately 6% rated their institutions as unfriendly; the remaining 10% responded “Don't Know.” Responses to corporate women-friendliness were less revealing. The most significant finding is that 72% of MentorNet protégés said they “Don't Know” about the women friendliness of MentorNet sponsoring companies, while 95% said they “Don't Know” about the women-friendliness of peer companies that are not MentorNet sponsors. Whether this difference (which is significant at $p < .001$), can be attributed to MentorNet sponsorship is not yet clear and will be explored in future reports. In this sample, employees of sponsoring companies mentored 29 respondents. Of these, 10 were seniors, masters, or doctoral students. Five of these students interviewed with their mentor's company. Seven respondents interviewed with other MentorNet sponsoring companies. So, there is some evidence that MentorNet protégés seek jobs with MentorNet sponsoring companies, especially if their mentor is from that company. Nevertheless, these data are merely suggestive and will be explored more fully in the future.

In the spring of 2000, IEG queried 1,089 students and their mentors in a year-end survey of the 1999-2000 MentorNet program. Overall response rates were 50.2% for proteges, and 46.3% for mentors; for the sample of 200 pairs particularly targeted for reminders and analysis, response rates were 57.5% for protégés and 56.1% of mentors. On a 5-point scale, with “5” being most likely, the average response of protégés to a question asking about their interest in staying in their major field of study was 4.42. When specifically asked to report on perceptions of effects of participation in MentorNet, average student response was 3.57 on a scale of 1-5 as to whether the program had affected their confidence in their skills, 3.60 on their desire to work in industry, and 3.74 on the program's effects on their desire to pursue employment in her field of study.

Discussion

MentorNet was initiated based on research and experience suggesting that industrial e-mentors could expand students' campus experiences, offering an improved understanding of the excitement, challenges, and opportunities available in industrial settings to those with appropriately developed skills, thus encouraging retention in science and engineering. While

some may be skeptical that use of electronic communications could have beneficial effects comparable to face-to-face mentoring programs, the opportunity to offer a mentoring relationship to many more students through a large-scale, technology-supported program using electronic communications made it worth testing. Thus far, evaluations document benefits to students and suggest that a positive effect on retention is achieved.

Comparative measures of strategies to address retention pose particular challenges. It is always difficult to separate the effect of a single intervention in an environment where many variables are operational. When mentoring constitutes a suite of tactics, which vary depending upon the particular nature of the relationship between any given student and her mentor, it becomes even more difficult. We have considered, but have not yet had the resources to develop, a control group for comparison purposes. Clearly, students self-select for a program like MentorNet, and one of our strategies for future evaluations is to begin to identify the characteristics of those who choose to take advantage of the opportunity. Another rough measure might be to compare retention of MentorNet students in engineering and related sciences with “standard” retention rates, yet finding a relevant national standard is nearly impossible; many schools do not collect this data, and too many other variables are likely to have greater influence than the mentoring experience.

Conclusion

While it is difficult to measure conclusively the effects of mentoring on the retention of women in engineering and science, the evaluation findings of a large-scale program like MentorNet can begin to document these effects in ways that go beyond anecdotal information. Preliminary evidence from evaluations suggest that even the relatively non-intensive experience of having an electronic industrial mentor generally has positive, reasonably long-lasting effects contributing to students’ interests, confidence, and/or likelihood of remaining in engineering and related sciences. Planned continuing evaluations will shed light on how deep, broad, and continuing these effects may be, as we are able to sample much larger populations, and follow them in time.

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