Mentoring Future Biologists via the Internet: Results from the *Electronic Mentoring for Tomorrow's Scientists* Program

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EXECUTIVE SUMMARY

Mentoring has a long tradition, reaching as far back as 1000 B.C. It continues to be practiced today in both educational and corporate settings. The process is typically established to help a protégé grow and develop new skills and attitudes. But science students in lower socioeconomic areas rarely have the opportunity to interact with mentors face-to-face. This is particularly true if the students are located in a rural setting, since most corporate scientists and their research facilities are concentrated in a few urban areas of the country. Few college students can travel to these sites as part of their college study, and few scientists have the leisure to travel to colleges and universities to interact with students there. If such contact were possible, students would be exposed to a much wider range of perspectives on scientific and professional issues.

The *E-Mentoring* program was designed to overcome some of these difficulties. Electronic mentoring, or telementoring, involves the use of computer-mediated communications (like e-mail or computer conferencing systems) to support a mentoring relationship when a face-to-face relationship would be impractical. It allows participants to communicate at their own convenience, eliminating geographical restrictions and lessening scheduling constraints. Furthermore, electronic mentoring often creates an environment where protégés feel more comfortable asking questions than they would in person or on the phone, and the use of written correspondence encourages reflection and allows participants to archive conversations.

The *E-Mentoring* program provided biology students from two historically minority universities in North Carolina with opportunities to interact and develop relationships with corporate scientists, to expand their learning horizons, and to use technology in a meaningful way. To provide a meaningful context for electronic mentoring for students, the project was integrated within appropriate biology courses, one undergraduate and one graduate, in Fall 1999 and Spring 2000, respectively. The Fall 1999 program was conducted at a rural university (11 students), with mentors from a large U.S.-based corporation (9 mentors). The Spring 2000 program was conducted at an urban university (9 students), with mentors from a large international corporation (12 mentors). The *E-Mentoring* software was developed on a WebCT platform, and included some group discussion forums (e.g., Students-only, Mentors-only) as well as a private forum for each mentor-student pair. Students and mentors were trained in computer-mediated communication, the mentoring process, and how to use the electronic mentoring software developed for this project. In addition, a structured "kick-off" event helped introduce mentors and students to each other, and Web pages containing background information on participants and their organizations further facilitated the establishment of mentor-student relationships.

To learn from this experience, an intensive evaluation was conducted. Each participant filled out a detailed questionnaire and was interviewed, both before and after their participation in the *E-Mentoring* program. In addition, messages between students and mentors were archived. These data were analyzed and the results are discussed in this report.

During the Fall 1999 semester, the 11 students and 9 mentors (combined) posted 231 messages; during the Spring 2000 semester, the 9 students and 12 mentors posted 571 messages. The overall difference in the amount of activity can most likely be attributed to two things. First, the organizational support for the project was much more evident in Spring 2000 than in Fall 1999. Second, the initial level of activity by the program mentors was much higher in Spring 2000: 4 messages per day were posted by mentors during the first month of Spring 2000, while only 1.4 per day were posted by the mentors in the equivalent period in Fall 1999.

An unexpectedly high level of activity was found among student-student interactions: 17% of the Fall 1999 student postings were to other students, 25% of the Spring 2000 student postings. Responses to the post-semester questionnaires also indicated that the students found the communication with their peers to be useful and fun, and that the Web-based technology was well-integrated into the courses.

The participants were generally positive about their experiences with electronic mentoring. Overall, participants had positive impressions of each other. Their responses to the questionnaire items concerning the quality of their relationships averaged 3.4 or above, on a 5-point scale. The questionnaire results also indicated several positive impacts on the participating students, including a personal relationship with their mentors (both semesters), enhanced career choices (Fall 1999), increased interest in science (Fall 1999), and increased use of technology (Spring 2000). Many students and mentors related incidents that provided evidence of positive relationships that formed between students and mentors. For several students, the mentoring relationship provided significant positive benefits: they developed a relationship with their mentors that is likely to be long-term, they got specific help with understanding science material and careers, or they received help that enabled them to improve their grades. For most students and mentors, e-mentoring was a pleasant experience, but there was no immediate important impact. It is possible that the impact of the relationship may be more fully appreciated upon later reflection. For a few students, the program was unsuccessful. They never developed a relationship with their mentors, and so the only benefit they received was the introduction and use of a new technological communication tool.

Based on the evaluation results from these two pilot studies, several recommendations for other electronic mentoring programs are made:

- Do implement such programs, if face-to-face mentoring is not possible. The benefits are worth the small investment.
- Ensure that the mentors' organizations provide explicit support for the program. Without a corporate champion, participation will not be enthusiastic.
- Ensure that the individual mentors are enthusiastic about their role. Their level of activity at the beginning of the program can have a lasting effect on the activity of the student participants.

- Begin with some type of kickoff event. It should allow the participants to become familiar with the software in an informal setting, and should introduce them to each other.
- Consider the technology platform that is most appropriate for the program. A Web-based platform was used for this project, but simple e-mail may be more advantageous in other settings.

I. INTRODUCTION

Ensuring that information and communications technologies are part of the educational culture in universities in lower socioeconomic areas is critical in light of studies revealing that, without access to Internet-based applications, underserved populations will be left further behind in their ability to achieve academic and career success (Hoffman & Novak, 1998). Research shows students using information and communications technology in educational settings:

- learn how to collaborate effectively (Cooper & Selfe, 1990; Gerson, 1993; Selber, 1994);
- develop a shared knowledge base (Gerson, 1993; Selber, 1994);
- express individual opinions with less fear of interruption (Cooper & Selfe, 1990);
- ignore socially constructed cues of class, race, and gender (Cooper & Selfe, 1990; Sproull & Kiesler, 1993); and
- learn marketable skills (Gerson, 1993; Selber, 1994).

Students who are afraid to speak, or are socially constrained, in traditional settings may find their "voice" in computer-mediated environments. However, if students do not have access to emerging technologies then institutions of higher education that are unable to keep pace with technology adoption will see a broadened chasm between their students' career aspirations and the training they receive to realize those aspirations.

Other research has shown that individuals in lower socioeconomic groups may not use information resources physically available to them because they distrust the resource or do not perceive it as relevant to their situation and context (Chatman, 1983, 1991, 1996). Thus, simply providing students with access to the Internet and its myriad of information resources may not impact their use of information and education. One approach is to involve students in relationships with mentors who can advise them about resources that would be most useful.

Mentoring has a long tradition, reaching as far back as 1000 B.C. It continues to be practiced today in both educational and corporate settings. The process is typically established to help a protégé grow and develop new skills and attitudes. But science students in lower socioeconomic areas rarely have the opportunity to interact with mentors face-to-face. This is particularly true if the students are located in a rural setting, since most corporate scientists and their research facilities are concentrated in a few urban areas of the country. Few college students can travel to these sites as part of their college study, and few scientists have the leisure to travel to colleges and universities to interact with students there. If such contact were possible, students would be exposed to a much wider range of perspectives on scientific and professional issues.

Electronic mentoring, or telementoring, involves the use of computer-mediated communications (like e-mail or computer conferencing systems) to support a mentoring relationship when a face-to-face relationship would be impractical. It allows participants to communicate at their own convenience, eliminating geographical restrictions and lessening scheduling constraints. Furthermore, electronic mentoring often creates an environment where protégés feel more comfortable asking questions than they would in person or on the phone, and the use of written correspondence encourages reflection and allows participants to archive conversations.

In 1999, the Partnership for Minority Advancement in Biomolecular Science (PMABS) at the University of North Carolina at Chapel Hill, established the Collaborative Electronic Learning Laboratory (CELL) in order to explore the use of existing and emerging technologies to facilitate equity of access to cutting-edge biomolecular sciences, as a means of contributing to the improvement of undergraduate science education. In collaboration with seven of North Carolina's historically minority universities, CELL conducts research on collaborative projects aimed at facilitating the integration of information technology into curricula at the partner universities.

One of the research projects sponsored by CELL is *E-Mentoring: Electronic Mentoring for Tomorrow's Scientists.* Using the Web as a platform, corporate scientists served as mentors to college students majoring in biology. Two pilot studies have been conducted: the first in Fall 1999 and the second in Spring 2000. Students were from two PMABS' partner universities; mentors were from two major corporations with research interests in biology. The project was developed and implemented by faculty and staff in the School of Information and Library Science at the University of North Carolina at Chapel Hill. The results of the two pilot studies are reported here.

Background

Students who participated in the *E-Mentoring* project face formidable challenges to the completion of their education. Enrolled in advanced biology courses at historically minority universities (HMUs) in North Carolina, most struggle to balance the responsibilities of school, work, and family. Often they are the first generation in their family to attend a university; many are single parents. While bright and ambitious, these students do not have access to the resources of well-funded research institutions or the expertise of a wide range of research scientists. Thus the E-Mentoring program recruited corporate research scientists to serve as their mentors, fostering relationships that nurture students' academic ambitions and expose them to alternate career options. The program aspired to both broaden students' scientific horizons and familiarize them with information and communications technology. Mentorships, which typically lasted a semester, were integrated with coursework and supported through a series of activities and Web-based application software that promoted communication between all participants.

The roots of mentoring reach back as far as 1000 BC (the first mentor appears in the Odyssey, acting as a father-substitute for Odysseus' son during the soldier's long absence). In our era, mentoring assumes a number of guises (Big Brother/Sister programs, structured programs for new employees, the informal practice of taking someone under one's wing, etc.) but generally serves to initiate protégés into new cultures, broaden their horizons, and facilitate the development of new skills. Mentors model expert performance, advise and encourage their partners, and clarify expectations and roles in a particular organization or context. Protégés benefit from emotional support and motivation, access to additional resources, receipt of knowledge and skills, introduction to "systems information" consisting of procedures, guidelines, and expectations (Wighton, 1993), and access to an authentic audience for their work (O'Neill, 1996). Yet successful mentoring relationships are reciprocal; mentors often enjoy developing interpersonal relationships with less-experienced colleagues (Sanchez & Harris, 1996) and appreciate the opportunity to explore subjects that interest them but do not claim precedence in their routine research (Sanchez & Harris, 1996; O'Neill & Gomez, 1998). In addition, corporate and academic cultures often provide mentors with indirect incentives;

volunteering in mentoring outreach programs may foster goodwill for an employee within his or her organization, or in competitive environments, protégés may be groomed as future political allies (O'Neill, 1996).

While mentoring programs within a particular site may be easily implemented, establishing mentoring programs when mentors and their protégés are physically separated is more challenging. The emergence of the Internet provides a new arena for mentoring relationships that could not be sustained face-to-face. Computer-mediated communications (CMC) allow participants to communicate at their own convenience, eliminating geographical restrictions and lessening scheduling constraints. Moreover, some research suggests that CMC lessens the boundaries of class, race, and gender (Cooper & Selfe, 1990; Sproull & Kiesler, 1993; Muller, 1997; O'Neill, in press). Students who are reluctant to speak in traditional settings may be less intimidated in cyberspace, posing questions that they would be reluctant to ask in person or over the phone.

Most electronic mentoring programs employ e-mail or Web-based discussion forums (i.e, asynchronous, threaded e-mail messages). While asynchronous communication inhibits the natural flow of conversation, its brand of informal written discourse is well suited to the learning process. Oral conversations are typically informal, unstructured, unfocused, and impermanent. E-mail and similar forms of asynchronous text-based communication formalize many aspects of oral conversation without resorting to the rigidity of formal letter-writing -- in many regards offering the best of both worlds. Composing e-mail messages requires forethought and reflection, crucial components of learning. Moreover, writing removes the burdens of performance; the writer transcribes her thoughts without the distraction of focusing on another person's reaction. Written communication also endures for future reference. Most text-based methods of CMC allow flexibility in design, easily accommodating either one-on-one partnerships or mentoring groups composed of multiple participants. Finally, text-based communication tools are cost-effective, e.g., free e-mail accounts are easily obtained.

Despite its advantages, CMC sacrifices much of the richness of face-to-face interaction (body language, tone of voice, facial expressions, etc.). Electronic mentoring programs must devise alternate interaction strategies to compensate for the absence of audiovisual cues, training participants to communicate effectively in the new medium. In addition, technical difficulties can interrupt relationships; hardware and software requirements must be assessed carefully.

The limitations of CMC and the possibility of diverse mentor and protégé perspectives make facilitation crucial (Harris, 1996). Most electronic mentoring programs include facilitators who act as coordinators, mediators, and cultural liaisons. When participants come from different cultural backgrounds, facilitators must ensure that these differences do not produce mismatched expectations in response times and message quality. They may also model appropriate writing styles, encouraging communication on both intellectual and emotional levels (Harris, 1996). Facilitators must also act as cheerleaders, maintaining morale and encouraging timely interactions.

Electronic Mentoring Programs

Some large-scale electronic mentoring projects have been established, each targeted toward a particular audience of mentors and protégés. Several programs connect primary and secondary students to experts who assist them with coursework. The largest of these is the International Telementor Program, originated at Hewlett Packard in 1995

(http://www.telementor.org/index.html), which enlists science and technology professionals to advise students (from fifth grade to college level) on teacher-supervised projects. Similarly, *Electronic Emissary* (http://www.tapr.org/emissary/) assembles teams of students, mentors, teachers, and facilitators to collaborate via e-mail on projects proposed by teachers.

Other programs are targeted specifically at women. One such program is *MentorNet* (http://www.mentornet.net/index.html) that pairs female university students with industrial scientists and engineers in an effort to encourage women to remain in the sciences. In 1999-2000, 2000 women at 70 campuses were mentored by 1,913 scientists and engineers. Another project focusing on women is *Telementoring Young Women in Science and Engineering* (http://www.edc.org/CCT/telementoring/), a three-year project sponsored for the Center for Children in Technology, seeking to expand the horizons of high-school girls. CyberSisters (http://www.cybersisters.org) is a program at the University of Oregon that connects undergraduate and graduate students with middle school girls. The mentor-protégé pairs work on projects selected by the protégés. The mentor-protégé interaction is both electronic and face-to-face. Preliminary outcomes from these programs have been largely positive. Protégés report increased interest in academic subjects (Cobb, 1999), improved writing or communication skills (Cobb, 1999; Sanchez & Harris, 1996), a boost in self-confidence (Cobb, 1999) and increased motivation to pursue career options (Tsikalas & McMillan-Culp, 2000).

Evaluation of Electronic Mentoring Programs

Evaluation of e-mentoring programs has primarily focused on informing the design of future programs. Evaluation results have shown that, although various programs have used different e-mentoring models, technological tools, and subject areas, there are similar characteristics necessary for success. For example, initial training should clarify participant roles (O'Neill, Wagner & Gomez, 1996), establish program goals and expectations (Muller, 1997), and introduce participants to communication tools. Single and Muller (1999) point out that matching mentors and students becomes more crucial in electronic mentoring; Tsikalas and McMillan-Culp (2000) suggest soliciting participant requests for partners. During the course of the program, participants must have frequent, regular contact (Tsikalas & McMillan-Culp, 2000; Harris, O'Bryan & Rotenberg, 1996). O'Neill (1996) suggests that this develops naturally when mentors and students feel responsible to one another in some way; mentors, for example, may contribute to the evaluation of students' work and should be apprised of students' progress. Bennett et al. (1998b) add that personal connections are crucial, concluding:

> In order for online conversations to lead to depth, intimacy, and sharing, students must feel (a) valued; (b) that their mentors are more than just email addresses and text on a screen; (c) that they are engaged in a relationship, one in which they are not just being advised but rather one in which they are putting out ideas and being listened to (p. 28).

Finally, practice makes perfect; participants in the *CoVis* project were more satisfied with telementoring relationships the second and third time around (O'Neill, Wagner & Gomez, 1996).

Evaluating the impact e-mentoring has on protégés is challenging because e-mentoring occurs within a context that contains a variety of variables, all of which may influence results. A general measure common to most evaluation studies is participant satisfaction which is measured through survey or interview questions (e.g., Bennett et al., 1998a, 1998b; O'Neill, 1998; Lichtenstein, 2000). Other outcome measures reported in the literature include social, career, academic, life-long and psychological benefits.

Social benefits are typically measured in terms of establishing interpersonal relationships and social networks (Ferneding-Lenert & Harris, 1994; Carlsen & Single, 2000; Lichtenstein, 2000; National Academy of Sciences, 1997). Literature has shown that scientists and other professionals often select colleagues for projects and positions based on their previous interpersonal knowledge of and personal preferences for individuals. E-mentoring can help create and maintain interpersonal and network relationships.

Academic benefits are applicable for e-mentoring programs that primarily occur in academic contexts. Measures focus on subject matter content, including increased breadth, depth and retention of the content (Dimock, 1997); course outcomes, such as graded project reports and presentations (Stephenson, 1998); decreased drop-out rates (Stephenson, 1998; Lichtenstein, 2000); strengthened study skills (Bennett, et al, 1998a); intellectual stimulation (Sanchez & Harris, 1996); tendency to ask more questions (Ferneding-Lenert & Harris, 1994); discussion of school matters and coursework (Bennett, et al, 1998a; Carlsen & Single, 2000); and tendency to join study and professional groups (Bennett, et al, 1998a). Unfortunately, because e-mentoring typically occurs in conjunction with other educational interventions, it is difficult to isolate and measure the academic benefits of e-mentoring.

Career benefits are applicable for e-mentoring programs that occur in academic and professional contexts. Measures in academic and professional contexts include increased knowledge of career paths, including increased awareness of mentor's lifestyle and change in career aspiration (Lichtenstein, 2000; Bennett, et al, 1998a; Carlsen & Single, 2000), increased job-seeking skills (Lichtenstein, 2000; Carlsen & Single, 2000) and change in perception of mentors or sponsoring company (Lichtenstein, 2000). Measures used solely in professional contexts include job retention (Lichtenstein, 2000), freedom to explore topics without interference of local politics (Echavarria & Mitchell, 1995), and increased or strengthened work skills (Carlsen & Single, 2000).

The psychological benefits typically measured include self-efficacy, as well as self-confidence and self-esteem (e.g., Mathew, Barufaldi & Bethel, 1998; Ferneding-Lenert & Harris, 1994; Lichtenstein, 2000; Carlsen & Single, 2000) and they are a component of all other benefits. That is, self-efficacy is used to measure self-confidence concerning social networking, ability to achieve in careers, academics and other tasks. E-mentoring should, ideally, increase a protégé's self-efficacy along these dimensions. Self-efficacy has been measured via pre- and post-surveys (Mathew, Barufaldi & Bethel, 1998) and interviews (Lenert & Harris, 1994).

The current *E-Mentoring* project learned from earlier programs, but was also designed to more closely observe the interactions between students and mentors in order to evaluate the success of the program and to understand the causes of its strengths and weaknesses. The evaluation of the project thus included data collection (questionnaires and interviews) with all participants before and after the program, as well as capture and analysis of the logs of the communications among participants.

II. EVALUATION METHODS

Overview

The *E-Mentoring* program was implemented in two pilot projects. The first was at Rural University, with mentors from Company 1; the second was at Urban University, with mentors from Company 2.[1] In each case, the student participants were members of a single class at the university. Prior to the beginning of the semester, each participant filled out a profile questionnaire, and mentors and students were matched. An interview was also conducted with each participant, and each person filled out a questionnaire concerning their expectations for the program. A kickoff event was held near the beginning of the semester, involving all participants in synchronous Web-based interactions, enabling them to be introduced to each other and to become familiar with the software. Project facilitators monitored the Web-based discussion forums regularly, identifying and resolving technical problems as they occurred. At the end of the semester, all participants again were interviewed and filled out questionnaires about their experiences.

Organizational Participants

There were four organizations that participated in these two pilot studies. In the Fall 1999 pilot study, students from Rural University and mentors from Company 1 participated; in the Spring 2000 pilot study, students from Urban University and mentors from Company 2 participated.

Rural University is a rural, undergraduate and historically minority university established in the late 19th century. This university enrolls about 1900 students, 75% of whom are African-American. Through its teaching, research, and community outreach, it seeks to identify and address the needs of its region of North Carolina, and over 30% of its students come from its home county or adjacent counties. It offers degree programs in the basic arts and sciences and in selected professional and pre-professional areas. The biology department offers courses in cellular, environmental, plant and animal biology.

Company 1 is a health care products and services company established in the 1970's. The company has approximately 1000 employees, many of them research scientists located in several states in the northeastern United States. Nine scientists from Company 1 served as mentors to the Rural University students. They were biologists and chemists, most working in Research & Development. Their impressive credentials initially intimidated the students, who were relieved to find that the mentors also possessed a sense of humor and commitment to family life. When Company 1 agreed to participate in the program, there was strong support from one of the vice presidents, who recruited the individual mentors. Unfortunately, he left just prior to the beginning of program implementation, at a time when the company was concurrently experiencing a significant number of layoffs. Thus, the mentors were somewhat concerned about the organizational backing of their participation.

Urban University was established in the early 1900's. It offers undergraduate and master's degrees in a variety of arts and sciences, as well as professional degrees in law, library science and business. The university enrolls approximately 5,600 students, 82% of whom are

[1] Participant names, including organizational names, are pseudonyms in order to protect the confidentiality of the participants.

African-American. The University maintains a commitment to academic excellence in a diverse educational and cultural environment. The mission of the University is to prepare students academically and professionally and to promote consciousness of social responsibility and dedication to the advancement of the general welfare of the people of its state, the United States, and the world. The biology department at Urban University has 16 faculty members and offers courses in molecular, environmental, plant and environmental biology.

Company 2 is a large, international research-based pharmaceutical and healthcare company that has evolved as a result of several large corporate mergers over the past decade. At the time of the *E-Mentoring* program, the company had approximately 16,000 staff involved in biological and pharmaceutical R&D activities, at more than 20 sites worldwide. The company valued mentoring and community service. Many employees had participated in internal company-wide mentoring programs, both as mentors and protégés. Employees were also encouraged to participate in community service projects; they were allowed to take time off on a weekly basis to do community service and such service was acknowledged during job performance reviews. Twelve employees from Company 2 served as mentors to the Urban University students. The employees came from several divisions in the US and UK, and had bachelor's, master's and Ph.D. degrees in a variety of fields including microbiology, molecular biology, genetics, biochemistry and training and development.

Individual Participants

The first pilot study involved 12 students and 9 mentors. Of these participants, one student dropped out of college altogether and, thus, was not included in the pilot study. The second pilot study involved 12 students and 12 mentors; two students dropped the course and one student was deported during the semester. The general characteristics of the participants who completed the entire semester are summarized in Table 1.

Table 1. General characteristics of study participants

		Students		Mentors	
		Rural Univ, Fall 99	Urban Univ, Spr 00	Company 1, Fall 99	Company 2, Spr 00
Number of participants		11	9	9	12
Age		20.9	25.3	43.4	36.7
Sex	Female	9	7	2	10
	Male	2	2	7	2
Race	White			9	9
	Asian/ Pacific Islander				3
	African-American/Black	10	9		
	African-American/Black, White	1			

Prior to the program, participants wrote short biographies detailing their academic background, career history and goals, and personal interests (see Appendix A). In addition, all participants completed questionnaires indicating their previous experience with technology and use of information resources (see Appendices B and C for the full pre-program questionnaires). Their responses related to technology use are summarized in Table 2.

Table 2. Technology-related characteristics of study participants

		Students		Mentors	
		Rural Univ, Fall 99	Urban Univ, Spr 00	Company 1, Fall 99	Company 2, Spr 00
Computer in use[1]					
At home	Macintosh	1		2	2
	DOS/Windows	4	3	6	3
	Windows/NT	4	5	1	8
	Other		1	1	1
	Not applicable	1	2		1
At work	Macintosh	1	3	1	1
	DOS/Windows	3	1	7	2
	Windows/NT	3	1	3	11
	Unix			1	1
	Other			1	
	Not applicable	1	2		
In university computer lab	Macintosh	2	5	2	
	DOS/Windows	6	3	2	
	Windows/NT	6	5		
	Unix	1		1	
	Not applicable			4	8
Browser in use	Netscape	11	9	7	12
	Microsoft ie	6	7	3	7
	Other		1		
Satisfaction with speed of Internet/WWW connections[2]					
From work		3.2[3]	2.1	3.0	3.5
From home		3.2[3]	1.9	2.5	2.5
From campus		2.9	2.2		

[1] Some participants reported more than one type of computer in use in a particular location.
[2] Four-point scale, Very Dissatisfied to Very Satisfied
[3] Responses from only 5 Rural University students.

The 11 Rural University students participating in the E-Mentoring program were junior and senior biology majors enrolled in an advanced course titled "Frontiers in Molecular Biology." The majority took the course because it is required for the major, but a substantial minority indicated that the professor's excellent reputation and the appeal of the subject matter also influenced their choice. *E-Mentoring* was a required component of the course; students' grades were affected by the extent of their participation. All but one student were enrolled in school full-time; half lived on-campus. Many hailed from families local to the area around the university; some were the first generation from their family to attend college, and several were single parents raising young children. The course professor emphasized the importance of exposing the students to the outside world; he himself had only realized the extent of their anxieties regarding unfamiliar experiences after accompanying several students to a conference in Atlanta. The *E-Mentoring* program, he felt, would present an ideal opportunity for students to explore unfamiliar ideas without being overwhelmed by the stresses of travel.

The 9 Urban University students participating in the E-mentoring program were first and second year graduate (masters' degree program) biology students enrolled in a course titled

"Advanced Genetics Biology." Similar to the Rural University students, the majority of Urban University students took the advanced genetics course because it is required for their major, but a substantial minority indicated that the professor's excellent reputation, the appeal of the subject matter, and the time when the course was offered influenced their decision to take the course. All but one student was enrolled full time, but only 2 students lived on campus. Approximately one-fourth of the students reported that the highest degree they expected to receive (from any university) was a masters; half expected to receive a PhD; and one quarter expected to receive a MD. As discussed earlier, *E-Mentoring* was a required component of the course; students' grades were affected by the extent of their participation. The course professor believed the written communication aspect of the program would be very beneficial for the students because it would provide opportunities for them to write and reflect on their writing.

Data Collection Prior to the Project

As described above, study participants provided information useful in generating a "profile" that would be communicated to other participants via the project Web site (see Appendix A). In addition, they filled out a questionnaire (see Appendices B and C). The questionnaires included items from the Flashlight Student Inventory, Version 1.0 (licensed from the TLT Group, formerly the Technology Projects of the American Association for Higher Education, AAHE, 1998), and the International (Hewlett-Packard) Telementor Program Evaluation (Cobb, 1999). The student questionnaire included items concerning academic standing and attitudes toward school, expectations of the *E-Mentoring* program, level of technology expertise and use, information use, and demographic data. The mentor questionnaire was parallel, except that it did not include the questions about academic standing and attitudes.

Interviews supplemented these questionnaires with detailed accounts of participants' experience with mentoring, expectations for the program, and noteworthy experiences with information seeking (augmented with "maps" of the information resources used by participants). The student and mentor interview guides are included in Appendix E.

The *E-Mentoring* Software

The E-mentoring software was largely embedded in WebCT™, a Web-based distance education application package. Extensive customization allows the general courseware package to meet *E-Mentoring* needs. During the spring and summer of 1999, members of the research team developed prototype interfaces for the program and usability testing was conducted. Our final implementation (Webster et al., 2000) ensured that the tools included in WebCT were fairly simple to use; this was crucial to the program since many students (and some mentors) lacked experience with information technology.

Our implementation integrated course-related materials with a variety of private and public discussion areas enabling communication between all participants. Each mentor/student pair had a private discussion forum (containing threaded, archived e-mail messages), and each participant had a private forum with the facilitators where administrative or technical concerns could be aired. In addition, each participant group had its own forum: Mentors Only, Students Only, Faculty & Mentors Only and Faculty & Students Only. An additional discussion forum allowed everyone to communicate openly. In addition, synchronous chat areas permitted real-

time conversation between participants.[2] The pilot semester revealed one weakness of the discussion forum model – participants' frustration at logging in to the Web site to check for messages only to find that none had been posted to them. During the second pilot study, a member of the research team routinely sent e-mail to alert participants of new messages.

A participant entering the password-protected Web site was presented with a screen similar to that shown in Figure 1. Each participant would view a slightly different opening screen with icons linking to his/her unique combination of discussion forums. (Inaccessible forums were hidden from view.) This particular screen belongs to a mentor who has two (fictional) students, Jane Adams and Angela Barry.

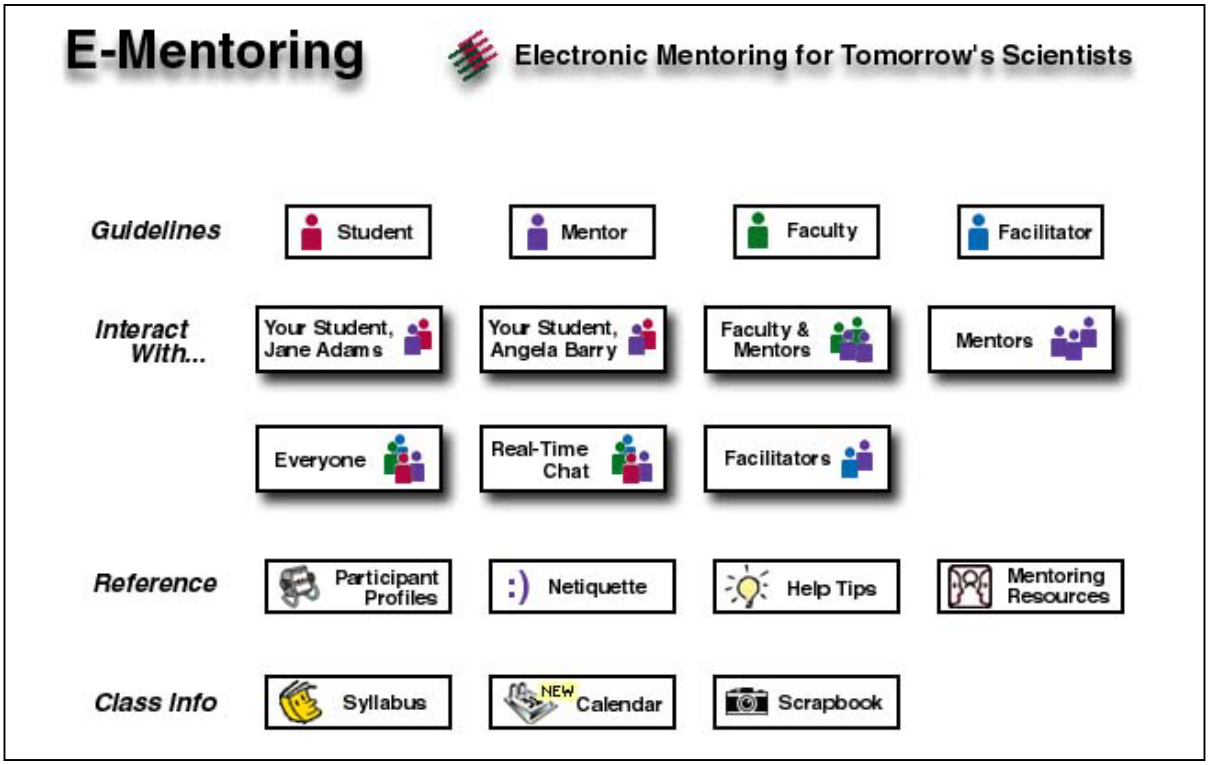

Figure 1. Sample opening screen from *E-Mentoring* software

In addition to communication tools, the system contained a number of static Web pages which all participants could access. *Guidelines* (accessed from the top row of icons) reinforced ideas shared during training sessions by giving an overview of mentoring, explaining its benefits to each participating group, and reiterating expectations for each role. For additional information, participants could visit *Mentoring Resources*, which connected to other electronic mentoring programs and articles describing them (it was the only area linking to Web sites outside the protected system).

[2] Unfortunately, the corporate firewalls in both Company 1 and Company 2 prevented use of the chat function from the mentors' offices. Thus, if the mentor and student wanted to use that function, the mentor needed to access the Web site from a location outside the office.

Materials in the *Reference* section elaborated on various issues related to CMC and mentoring. The *Participant Profiles*, featuring pictures and autobiographies of each participant, removed some of the anonymity of text-based communication. The *Scrapbook* supplemented these profiles with photos from the kickoff event and pictures of university and corporate campuses. A Web page explaining *Netiquette* offered tips on expressing oneself effectively in cyberspace (emoticons, typing conventions, etc.).

Finally, the *Class Info* area incorporated course-related information. The syllabus included instructions for labs and assignments, a schedule of topics to be covered, evaluation criteria, and references, among others. The interactive *Calendar* allowed any participant to post a private or public entry. Important dates in university and corporate schedules were posted to keep participants apprised of times when their partners would be unavailable or in need of special support (including birthdays).

Program Implementation

Information gleaned from the early data collection activities (see Appendix A) was used by the facilitators and the faculty member to match students with mentors. The project facilitators then worked closely with the faculty members, to ensure that *E-Mentoring* was well integrated with coursework, and with the mentors, to ensure that they were able to support the students' development. The list of pairs for each semester is included in Appendix F.

Participants were introduced to electronic mentoring in a training session offering hands-on exploration of the software. After learning the purposes, structure, and goals of the program, the participants completed a variety of tasks designed to familiarize them with the Web-based communication tools. A second, more festive orientation was the kickoff event, the sole occasion during the semester when all participants were simultaneously online. Intended to make participants comfortable with the software and each other, the kickoff included a getting-to-know-you activity, small group discussions of science and/or career issues, and opportunities for student/mentor pairs to share expectations and scheduling constraints. This exchange, excerpted from a small group discussion about visiting the Amazon to locate a rare medicinal plant, demonstrates the lighthearted tone:

> Linwood (mentor): Would YOU volunteer to visit??
> Jacki (student): I think I'll pass on that one. . .
> Linwood: Aw come on, Jacki-- they probably have some pretty good restaurants down there!
> Jacki: I prefer nothing raw.
> Linwood: Are you a vegetarian ? We might have to keep you away from this plant if you are!
> Jacki: I'm not a vegetarian, but I would perfer (sic) my food cooked over an open flame, maybe a stove, hot plate, grill!

Clearly participants enjoyed the interchange; this opportunity to chat casually seemed to assuage participants' anxieties and generate enthusiasm for the upcoming semester.

Following the structured kickoff event, conversations developed naturally, according to individual interests; participants were free to discuss the subjects of their choice. As O'Neill (1996) points out, "the biggest problem in organized telementoring is to set up conditions which will encourage sustained, meaningful discussion. . . between students and their mentors." Thus the *E-Mentoring* facilitators monitored messages to ensure that mentorships were proceeding smoothly, posting suggestions for discussion topics when communications lag.

Data Collection During and After the Program

During each pilot semester, all the messages posted to all the discussion forums were collected and archived for later analysis. These logs included the name of the person posting the message, the date and time at which it was posted, a subject line, and the text of the message. The subject line was automatically provided by the system (but could be edited) if the message was posted as a reply to an earlier message.

At the end of the semester, each participant responded to a questionnaire and was interviewed. The questionnaires were very similar to the pre-program questionnaire, and are included in Appendices G and H. Additional items focused on the participants' evaluation of the program (including the technology used in its implementation) and the program's effects on students' academic progress and use of technology. The post-semester interviews were also very similar to those conducted prior to program implementation, with additional questions concerning their reactions to their partners and the program as a whole (see Appendix I for the interview schedules).

Data Analysis

Questionnaire data were analyzed quantitatively. Frequencies were calculated for categorical and ordinal variables, e.g., selections from a list of program effects. Means and standard deviations were calculated for interval/ratio variables, e.g., Likert scales rating the participants' perceptions of the mentor/student relationship. When appropriate, within-subject pre/post comparisons were tested using a correlated t-test.

Audiotapes of the interviews were transcribed and content analysis was conducted. The themes related to participants' evaluations of the program were induced from the data and used to enrich our understanding of the questionnaire results. Interview data related to participants' information seeking processes, along with the maps of the information resources they used, were analyzed separately, in order to understand the participants' information horizons and how they were affected by program participation. These methods and preliminary results have been reported elsewhere (Sonnenwald & Wildemuth, 2001).

The message logs were analyzed in various ways. The frequency of posting by each participant and in each forum was counted, as well as the number of threads and thread length. The number of words in the messages was analyzed. The interactivity of each forum, i.e., the proportion of postings that were in reply (explicit or implicit) to prior postings, was analyzed using graphical methods developed by Henri (1992).

III. RESULTS

The large amount of data collected during these two pilot studies is summarized in this section. The section begins with an overview of the characteristics of the participants, including their academic- and technology-related attributes. The evaluation results include the findings concerning student and mentor expectations and concerns about the program, the interactions between students and mentors, participants' perceptions of the relationships between students and mentors, and the impact of *E-Mentoring* on the students' academic lives and all participants' technology and information use. The questionnaire, interview, and log data that were collected during the study have been integrated in order to provide multiple perspectives on each aspect of the evaluation.

Participant Characteristics

Academic characteristics of students. As noted above, the 11 Rural University students participating in the *E-Mentoring* program were junior and senior biology majors. The 9 Urban University student participants were primarily graduate students enrolled in a masters' program in biology. The students' academic characteristics are summarized in Table 3. The students at Rural University were near the end of their undergraduate programs; the students at Urban University were near the beginning of their graduate work. Most students were full time, but did not necessarily live on campus. Most of the undergraduates at Rural University expected to pursue graduate degrees, and most of the masters' students at Urban University expected to go on for a Ph.D. Most students' academic performance was good (GPA reported as A or B). A detailed list of the biology-related courses already taken by the students is included in Appendix D.

Table 3. Academic profile of participating students

		Rural Univ, Fall 99	Urban Univ, Spr 00
Credits completed		114	16
Number of participants that were full-time students		10	8
Number of students living on campus		5	2
If living off campus, hours per week spent on campus (mean)		7.8	12.3
Number of students expecting to earn degree from this university		11	12
Highest degree expected (from any university)	BA	3	
	MA	2	3
	PhD	3	7
	MD	2	3
	Other	1	1
GPA at the end of the previous semester	A+ or A	2	3
	A- or B+	4	5
	B or B-	4	1
	C	1	2
	D or F	0	0

In addition to their general academic background, students provided information about their reasons for taking college courses (see Table 4), selecting all that apply from a list of possibilities. Most students were taking college courses to earn a degree or for personal enrichment.

Table 4. Students' reasons for taking college courses

	Rural Univ, Fall 99	Urban Univ, Spr 00
To advance in current job or career	4	4
To discover new job opportunities	6	6
Personal enrichment	7	8
To earn a college degree	11	8
Other	1	2

Students were also asked about their reasons for taking the specific course that included participation in the *E-Mentoring* project (see Table 5). Specifically, they were asked to select all the reasons that applied, from a list of possibilities. The most frequently-cited reason was to fulfill a requirement for their major.

Table 5. Students' reasons for taking the course involved in the *E-Mentoring* project

	Rural Univ, Fall 99	Urban Univ, Spr 00
To fulfill a general education requirement	1	6
To fulfill a requirement for my major	9	11
The subject matter looked interesting	3	3
The instructor has a good reputation	4	6
It was offered at a convenient time	1	3
It was offered at a convenient location	1	1
It was offered via … technology	0	0
Other	2	2

Technology background of students and mentors. Students and mentors were asked about their current uses of computers and their computer skills. One item on the pre-semester questionnaire asked about the amount of computer use (see Table 6). Over half of the undergraduates from Rural University used computers 1-5 hours per week; the graduate students at Urban University were slightly heavier users, with half of them using computers 5-10 hours per week. The mentors in both companies were quite heavy computer users, with almost all of them using a computer over 20 hours per week.

Table 6. Amount of computer use by study participants (hours per week)

	Students		Mentors	
	Rural Univ, Fall 99	Urban Univ, Spr 00	Company 1, Fall 99	Company 2, Spr 00
Less than 1 hour				
1-5 hours	6	2		
5-10 hours	3	4	2	
21-40 hours	2	2	4	1
Over 40 hours/week			2	10

Table 7 presents data concerning the ways in which participants use computers, as reported at the beginning of the semester. Each respondent to the questionnaire was asked to indicate the two activities that represent most of their computer use at work/school and at home. Students at Rural University were most likely to use a computer for word processing or email at school, and for word processing and playing games at home. The students at Urban University were most likely to use the computer for accessing the Internet and word processing at school, and for word processing at home. The mentors in Company 1 used their computers mainly for word processing and email at work and for accessing the Internet at home. The mentors at Company 2 were most likely to use their computers for email and word processing at work and for graphic design at home. Thus, in spite of the differences between students and mentors in *amount* of computer use, the *types* of uses were quite similar.

Table 7. Computer uses of study participants

	Students				Mentors			
	Rural Univ, Fall 99		Urban Univ, Spr 00		Company 1, Fall 99		Company 2, Spr 00	
	School	Home	School	Home	Work	Home	Work	Home
To play games	1	6		2		2	4	1
For word processing	8	7	5	5	8	4	7	2
For class projects	5	2	1	1			4	2
To use e-mail	7	3	3	3	6	2	10	2
To access the Internet	5	2	7	3	3	6	3	4
To do graphic design		1				1	1	6
To design Web pages							3	1
To do programming							2	2
Other							1	4

Study participants were also asked to rate their skills (on a 5-point scale) in performing a variety of computer-based tasks. The mean ratings (and standard deviations) are reported in Table 8. Both the students and the mentors were quite comfortable with word processing, email, and Web searching; and the Rural University students were comfortable with online chat sessions.

Table 8. Computer skills of study participants (means and *standard deviations*)

	Students		Mentors	
	Rural Univ, Fall 99	Urban Univ, Spr 00	Company 1, Fall 99	Company 2, Spr 00
Create a word processed document on a computer	4.2 *(1.2)*	4.3 *(0.7)*	4.8 *(0.4)*	4.7 *(0.5)*
Send and receive e-mail	4.8 *(0.4)*	4.6 *(0.5)*	4.7 *(0.5)*	4.7 *(0.5)*
Search for information on the Internet/WWW	4.6 *(0.7)*	4.5 *(0.5)*	4.4 *(0.5)*	4.0 *(1.1)*
Participate in online chat sessions	4.1 *(1.4)*	2.6 *(1.6)*	2.0 *(1.0)*	2.4 *(0.9)*
Participate in threaded e-mail discussions (i.e., use electronic bulletin boards)	2.5 *(1.2)*	1.3 *(0.5)*	2.4 *(1.1)*	2.8 *(1.3)*
Create or edit a World Wide Web site (using such programs as html, java, etc.)	2.5 *(1.0)*	1.8 *(1.0)*	1.3 *(0.7)*	2.0 *(1.2)*
Electronically send and received files by way of the computer (over a modem, the Internet/WWW, etc.)	2.6 *(1.3)*	3.0 *(1.4)*	3.9 *(0.8)*	3.8 *(1.1)*
Program a computer using a programming language (such as Fortran, C, C++) or a database language (such as FoxPro or Oracle, etc.)	1.4 *(0.5)*	1.4 *(1.1)*	2.0 *(1.1)*	1.8 *(1.4)*

Note: n=8 students for Spr 00

Student Expectations

Overview. The questionnaire asked students to select the top three ways in which they expected to be affected by their mentors. Their responses are reported in Table 9 In the first pilot study, the students most often expected that interactions with their mentors would enhance their career choices, increase their use of technology, and improve their grades. In the second pilot study, the students were more selective in their expectations, with enhanced career choices and increased science proficiency being the most frequently expected effects of mentoring.

Table 9. Student expectations of mentor impact

	Rural Univ, Fall 99	Urban Univ, Spr 00
Increased interest in science	3	
Increased science proficiency	4	6
Improved grades	6	
Enhanced career choices	9	7
Increased motivation to succeed at school	3	1
Increased self-confidence	1	
Increased involvement at school	1	
Increased use of technology	7	4
Developed friendship, personal relationship with mentor	5	4
Other	1	

Prior experiences with mentoring. During the interviews, most students described previous positive experiences with mentoring and/or being mentored, some in formal programs

and others informally. One Rural University student appreciated the guidance she received while doing research with a professor there. Another who had counseled freshmen at her university said she enjoyed offering advice about teachers and classes because she hoped the younger students wouldn't make the same mistakes she had as a freshman. One Rural University student said mentoring younger students as part of a community service project showed her how different people handle different situations. One Urban University student had experienced both sides of a mentoring relationship, as a "little sister" and a "big sister" in the same program. One Urban University student talked about the emotional benefits of being a mentor:

> Invergordon: There was this young boy (at church) that I was helping with some math and some English, and I appreciated the glow when he finally got it, when I was able to help him to get to that point, because it was always within his reach but he didn't recognize that until we worked at it. And so that was, that was very good. And just knowing that I had a part in that, that was good too, but even better, he was able to walk away from that situation and didn't need me anymore.

Several students mentioned that they continued to maintain contact with people who had mentored them in the past, and one said that her lasting relationships made her optimistic about participating in this program.

> Albertson: My mentor at home now is a good friend of mine. I still go to this guy for advice and help. As a matter of fact, I networked with him in getting the job that I have here now on the campus… I know it works, you know, so…

Expectations about relationships with mentors. Many students (five at Rural University and three at Urban University) said they wanted a close, friendly relationship with their mentors, but "close" and "friendly" didn't necessarily mean personal.

> Ingram: I want a close relationship (where) I could talk to him about just – well, not anything, but you know, things that concern me with academics, graduate school, my research, I mean, anything … pertaining to making [me] a better person.

Five Rural University students said they expected the program to be a learning experience that would introduce them to new sources of information and improve their computer skills. Ten of the 11 Rural University students said they wanted to discuss coursework, topics they were stuck on in class, careers and jobs, and graduate school opportunities. Ten of the 12 Urban University students wanted to discuss coursework and classes, careers, and graduate school opportunities.

Three Rural University students and two Urban University students said they wanted a student-professor relationship with their mentors. Another Urban University student expressed a desire for a flexible, "relaxed" relationship that blended teacher-student interaction with more informal discussion, while two others described a "mutually beneficial" relationship that motivated both participants in their work. However, one Rural University student said he didn't plan to ask his mentor questions he could ask his teacher because he didn't think the mentor had time for that:

> Keyes: They're not dedicatin' their life to bein' a teacher, so I wouldn't wanna trouble them with a teacher question. … They're out in the industry. These teachers haven't been in the industry for years … half of `em haven't worked in a lab since they got their Ph.D., you know, so they're hardly even up-to-date on the real techniques. So, I mean, I would wanna know … is the technique I'm usin' in this experiment, you know, so out-to-date that when I put it on my resumé, they're gonna laugh [at] me?

Many students (seven at Rural University and four at Urban University) thought they would gain encouragement, motivation and direction and inspiration. For example, one Rural University student hoped the experience would bolster her commitment to continue her studies:

> Elkan: Sometime I get confused at what I wanna do. You know, it's like, I've got 10 more years – uhh! it's so far! I just got *here*, and – you do get kinda down sometimes. … You end up working hard, and you end up gaining something for it, but sometimes it's good to hear it from somebody that has worked that hard. … I just want to know, is it worth it?

Some of the students were looking for advice about further study in biology. The students at Rural University were near the end of their undergraduate education, and some were hoping to gain a better sense of professional direction:

> Ingram: I want to go to grad school, that's a definite. I'm not for sure what type of field I really want to enter. I like biochemistry, I don't know if I want to enter into the general side, or the more specialized side. I'm hoping that a mentor will help me, guide me into, you know, which career, which side of the biochem I need to enter into; which one is the best as of right now.

The graduate students at Urban University were primarily in masters' programs and some had questions about the value of pursuing a doctorate:

> Babcock: Is it going to make a world of a difference if I have a master's as opposed to having a Ph.D., bearing in mind what it is I want to do ultimately?… What are some of the institutions that he or she could recommend to doing a Ph.D. …the length of time (and) how, how, how can you live while doing a PhD and not be a professional student?

Some of the students were more interested in discussing topics unrelated to science or school, such as balancing a home life with a professional life.

> Invergordon: I would expect that my mentor would be able to provide some professional advice. My hope is that this person would be in some way knowledgeable of my interests. … I'm a mother and I'm married so my hope is that this person may be somewhat familiar with the challenges of, you know, bringing those other things to the playing field because I'm different than some of the other graduate students, and I've been … away for a few years and coming back into it.

Two Rural University students wanted to also specifically discuss the steps mentors took to get where they are. One said it was never too soon to start networking:

> Keyes: I think they could offer a lotta shortcuts that can help my life. … They went through the same thing I went through maybe 39 years ago and maybe a tad bit different, but – they, you know, they still have an idea. You know, they may be the one hiring for their company. … They may be the one, you know, recruiting.

At Urban University, all 11 students thought their interactions with their mentors would yield beneficial information, advice, and/or contacts. One Urban University student said his mentor could offer a perspective he couldn't get from those closest to him:

> Edwards: I'm the first person to get anything beyond a BS degree and, you know, I'm…I really don't have somebody in my family to look to for advice.

One student at each university noted that the timing was opportune for such an experience:

> Babcock: It comes at the right time. I think I'm at the point where I probably need a mentor. … I'm like a sponge right now. I'm open to all the possibilities that there are in order to make an

evaluation of the situation. So I'm just hoping that my mentor will be able to flood me with all this information regarding what's out there in the science world.

Forester: Hopefully, in the best possible world, I can make some contacts. I'm graduating in May so I'm looking for a summer job or some kind of summer program or internship. So, hopefully that will advance that.

Student impact on mentors. The experiences of other e-mentoring programs, such as that established by Hewlett-Packard, would lead one to expect a beneficial impact on the participating mentors (Adams, 1999). Some students (four at Rural University and four at Urban University) thought the program would make mentors feel good about themselves or motivate them to help students more.

Early: Maybe this will bring somethin' into their lives where they feel like they're helping somebody go into a career that they love.

Four Rural University students and two Urban University students also said they hoped that, through this program, mentors would see that students work hard and are good people. Another hoped to break stereotypes:

Ingram: A lotta times they basically consider the students – the people that was born in the late 70s and the early 80s – as Generation X, people that don't really want to do anything… Hopefully he will see there are some students that are really committed to research, committed to actually, you know – hmm! – to be a better person. Hopefully he will see a person that, you know, will keep on tryin', whether I'm tired or whether I make mistakes, keep on tryin', keep on tryin', keep on tryin'. The Little Engine, you know, "I think I can, I think I can."

Two others said they thought the program would give mentors a new perspective on students, and one student said the mentor might learn things he/she didn't already know.

Characteristics of mentors. As for desired characteristics in a mentor, seven Rural University students wanted a mentor who was willing to help and interact frequently. Three mentioned patience, two each mentioned intelligence and a down-to-earth quality. Other qualities included having similar interests and being trustworthy, honest, nice, polite, interested, and a good listener.

Early: I hope maybe open and talkative and wise. Wise in where they know, uh, that I'm still a kid and … that I have to do things on my own and they (shouldn't) just *give* advice – not really sayin', "You *should* do this," or "You *should* do that." But mostly to say, "Well, I recommend such-and-such."

The Urban University students also mentioned a variety of traits, including: intelligence, trustworthiness, honesty, listening ability, sense of humor, communication skills, friendliness, willingness to learn, ability to be understanding and patient, resourcefulness, genuineness, competence and openmindedness.

The Effects of the Electronic Medium. Several Urban University students shared expectations about face-to-face vs. electronic communication. One expected the electronic format to take away "the personal edge" but acknowledged it probably would facilitate more frequent communication because it wouldn't involve accommodating two schedules. Another said the Internet would remove the tendency to stereotype people based on looks. Another predicted that the lack of visual cues would hinder successful communication:

Henshaw: I think it's going to make if more difficult because sometimes people can take out of context what you actually type in the computer versus being able to actually see someone and see their body language and how they're taking things. I think that way might be more difficult.

Finally, three Urban University students said they would want to meet their mentor, and two Rural University students said they wanted post-program contact.

Mentor Expectations

Prior experiences with mentoring. Most mentors described decisively positive experiences either being mentored or mentoring others. Some even described moments of contact that really made a difference in their lives, though the person who influenced them often wasn't a formal mentor. One mentor described being intimidated by the expertise of the professor and classmates in a course he took in nuclear particle physics as a college freshman:

Franklin: At the end of the year, we had to write an evaluation of the course. And I just said, well, I mean from the get-go I was just overwhelmed and I didn't understand a word – you know, stuff like that. [laugh] And, so he wrote back, "It is your sacred obligation as a student to ask questions until you understand" – underlined, underlined, underlined. [laugh] … That was actually, pretty much a life-changing moment. 'Cause, he sort of reminded me what I was about. And, actually, I think most kids need to be held to that standard when they're students.

One mentor at Company 1 talked about a professor he had as an undergraduate who was "infectiously enthusiastic" about science; that contagious excitement was a factor in the mentor's decision to go back to graduate school. Others mentioned supervisors and family members who had inspired them:

Yu: The person that you have as your mentor, it's quite an important choice. I actually chose a female colleague and that wasn't entirely at random. … Through talking to her I realized that she'd experienced a lot of the feelings that I was having about speaking up and making your presence felt. So It was, it was really, really useful talking to her … She actually just gave me the encouragement I needed to take on new challenges and, you know, we don't actually meet regularly anymore but I'm still working on some of the issues that we did raise together, and that's been really, really useful.

Ross: I would love it if it turned out that I could have an impact on them the way some people have had an impact on me in the past. I was just thinking about why am I interested in biology, for example, the impact that my physician grandfather had on me. And I, as I look back I, I realize… that he did have that impact on me and that that could have, you know, may well have directed my life in a certain path. I admired him a lot and he encouraged me... So I guess I would like to impart to the student some vision for the future for themselves and would like to play a part in their attaining of, you know, a brighter future for themselves.

Other mentors spoke of their positive experiences in mentoring students. For example, one mentor's efforts to help a young person had a tangible and satisfying payoff:

Mason: One (student) I realized was paying his way through school, he had all these odd jobs. So I actually went to (management), and I said, "He's done a really great job in the lab this summer, I could use the help going into the full year. Could we find some money to pay him?" … Turns out that now he's an employee here.

Another mentor talked about starting a mentoring-type program at her company that would target students ages 11 to 15 and involve them in scientific projects:

Mulroney: In the UK they get streamed … by the time they're fourteen. So before they get streamed, we want them to sort of start thinking about what science can offer. … We will assess the projects using some key people within the industry. And then we will, we were hoping to award prizes, and then they could see whether they enjoyed that.

Other mentors pointed out concerns they had about the mentoring process. For example, a mentor in Company 2 commented on the informality of mentoring:

Thompson: I think sometimes we're being mentored and we don't know we're being mentored. So whether it be your parents or your supervisor or your, you know, someone who's taken an interest in your career or an interest in you, in discussing things with you. So mentors can be, they don't have to be hierarchical, you know. And mentors can also be from the bottom mentoring up, you know, as to what to do in an organization.

One mentor in Company 1 had negative feelings about past mentoring experiences that colored his feelings about this program:

Franklin: My general experience with (such programs) is that students are reluctant to use them. … I've worked now almost 20 years in the local science congress, and we have a whole stable of mentors available to high school students, in every discipline you can imagine; and, you know, we let kids know this, and they just virtually never call. 'Cause they – I don't think they really believe that there are people who would actually like to work with them on their projects.

Motivations for participation. During the interviews, four mentors said they agreed to participate because management asked them to do it and it would help their careers. Two said it was an easy way to fulfill a work obligation and help someone at the same time. Three mentors in Company 1 and two in Company 2 said they agreed to join the program because they like working with students and teaching.

Waldheim: I'd like to sort of convey to them … there's a lot of different areas of research going on out there and there's a lot yet to be discovered and…there's a lot of really interesting work to be done. And you may not get … very rich doing it but, but, you know … you should be looking for other than financial rewards.

Four Urban University mentors volunteered because they wanted to help students who didn't get anough of the encouragement or help they need.

Mulroney: I have a great interest in trying to promote science in schools. … (especially in places) where the ethnic minorities are the largest percentage of schools so they tend to be in the sort of inner cities. I find that they don't have the right kind of encouragement or they don't seem to be interested and they don't have any role models that they can work with in order to, you know, proceed. … Those who are not performing and so on are just essentially ignored when, most of the time, they just need a little encouragement and somebody who will actually spend some time saying, "Yeah, you can do it, too."

Three Urban University mentors said they wanted to pass on their love of science.

Vincent: I've just always enjoyed trying to pass along my enthusiasm for a career in science. And especially as a woman in science, I like feeling like I may be breaking down some of the prejudices that, you know, it's just not something real women would do or attractive women might do. … I didn't have many models of that when I was coming up, especially models of women who were successful at being able to balance their career as a scientist with home life and family. So I'd like to be a person like that.

Mentors also said they wanted to learn more about mentoring or wanted to help students learn more about careers at their company. One mentor was interested in the technology used in the program:

> Quest: (I'd like) to see how these programs are formatted and how they are run … (to see) if this technique can be transferred to situations in, say, India, where there is probably a huge need for teaching of, for teaching the students from a distance … simply because schools are not available at all places and sometimes because of economics, the students don't have the option of going to the school whenever they please. So in that case, we do need the school to come to the students and I think e-mentoring or these kind of processes are an excellent way of doing it.

Impact on students. Parallel to the student questionnaire, the mentor pre-semester questionnaire asked them to state which effects they believed they were most likely to have on the students. Their responses are summarized in Table 10. The mentors in Company 1 expected that their interactions with students would provide enhanced career choices and increased interest in science. The mentors in Company 2 expected to bring to their students enhanced career choices, increased interested in science, and increased motivation to succeed in school.

Table 10. Mentor expectations of mentor impact

	Company 1, Fall 99	Company 2, Spr 00
Increased interest in science	5	8
Increased science proficiency	1	3
Improved grades		1
Enhanced career choices	6	9
Increased motivation to succeed at school	3	7
Increased self-confidence	3	5
Increased involvement at school		1
Increased use of technology	2	3
Developed friendship, personal relationship with mentor	3	3
Other		

The majority of mentors (six at Company 1 and eight at Company 2) saw their impact on students as offering students new perspectives on the field and industry.

> Vincent: I'm hoping that I'll move the student from a place perhaps of thinking, "I may not be good enough for this career," or maybe, "I just don't know what it's about. I don't think I'm really interested. I think it's a bunch of nerds in white coats and I don't really see myself that way" to "Oh, you know, no, it's not really that, it's people doing a job and they're normal people just like me and they have families and they have hobbies, and they got there, you know, through a process that I'm going through now so it's completely within the realm of possibility that I might go the same way."

Some hoped to pass on advice related to education- and career-related decisions which they had made in the past and which the students were facing currently:

> Grimsby: When I look back at the programs I went through, and how I put myself in the position to get a career, there's certain things I would do very differently. …Those choices, you know, as minute as they seem at the time, those can be opening or closing certain doors on you, without you knowing it.

> Chen: If you want to go anywhere in a company, scientifically, you need a Ph.D. And I guess I would want to impart that to them; if they really want to be in this field, they should go on.

Others said they wanted to offer more general advice, act as a resource or simply encourage their students:

> Mulroney: I certainly don't expect to have all the answers, but at least if I can point them in the right direction, that's the sort of impact I was hoping that I would have.
>
> Logan: I think the biggest impact that I could possibly have is just to show them that there's possibility out there. … Having someone there to instill … confidence in you occasionally is not such a bad thing. … Some people live within a box and say, "This is all I can do," when in fact they can do a lot more; they just need to see it. They need to see the "more."

Only a few (two at Company 1 and one at Company 2) mentioned wanting to pass on straight scientific knowledge. It appears that the mentors distinguished this factual, cognitive aspect of their influence as distinct from the more affective influence represented by their questionnaire responses indicating that they expected to increase the students' interest in science.

Several mentors said that they had high expectations for the students. Seven mentors at Company 2 and four at Company 1 said they expected students to be intelligent, interested, curious about science, and motivated and excited about the program. A few mentors worried that their students might need direction or expect a relationship they couldn't provide.

Mentors' expectations for effects in their own lives. On the questionnaire and in the interviews, mentors were also asked what effects they expected their participation to have in their own lives. On the questionnaire, they were asked to selected the three most likely effects of the program; their responses are reported in Table 11. The most common expectation in both companies was that they would gain personal satisfaction from helping others. In Company 1, the mentors also expected to develop friendships and personal relationships with the students. In Company 2, they were more likely to expect to gain more experience in mentoring and to learn (or re-learn) about biology topics not currently the focus of their work.

Table 11. Mentor expectations for program effects on their own lives

	Company 1, Fall 99	Company 2, Spr 00
Help meet organizational goals by developing future employees and increasing diversity in the workforce		5
Develop my professional network by making new contacts	1	2
Gain personal satisfaction from helping others	6	10
Gain more experience in mentoring	3	7
Increase my own use of technology	1	4
Learn (or re-learn) about biology topics that I wouldn't otherwise take the time or opportunity to explore	4	7
Learn about contemporary science education at the university level	4	3
Meet people who are different from myself (in age, race and ethnicity, cultural background, etc.)	4	4
Develop friendships, personal relationships with students	5	3
Other		

Many mentors (four at Company 1 and six at Company 2) saw students' impact on them as giving them new perspectives, both on science and social issues.

> Franklin: I expect them to frame questions in a way I wouldn't. You know, once you've kind of arrived in an area, you have a particular way of looking at things. And they're still forming their own, sort of, scaffold. And so I expect they're gonna come at things a little differently than I do, and that will be good for me in the end.

> Logan; Um, who was it? – there's one of these gurus out there that I would hate to steal a quote from, but, "To influence, you also have to be influenced." Eh, so I expect that in return, more or less, that they will somehow better my life in some way. Perhaps they don't know that yet, but they will educate me, expose me to something that I haven't been exposed to before. And that can't be bad!

Some mentors were most interested in the "science" components of mentoring. Two mentors in Company 2 wanted to learn new concepts, and two others thought the program would help refresh their memories on old concepts.

> Yu: … having to revisit things that you might have learned at university or learnt at school ages and ages ago, and it never does any harm at all to have to go back and relearn those things. It's the best thing in the world having to explain it to somebody else because it really makes you understand it.

Other mentors expected the primary benefits to come from exposure to students who were different from themselves in race and socioeconomic background.

> Grimsby: Mentoring, as I said, is a two-way street. In this particular case, I probably won't learn much science from these people, but I may, you know they're from a different sociological background … I may learn some, you know, some different ideas of where they're coming from, how they're thinking.

Two mentors had children in college and said they hoped the program would provide some insight into what today's students experience. After listening to program facilitators describe the learning environment at Urban University, one mentor said he hadn't realized how different it was from his daughter's experience at a private university in North Carolina:

> Ross: What she told us about their environment was, was eye-opening. … For example, she said that the, the students don't have access to computers except, you know, maybe at a computer lab … That's in contrast to my daughter who has, who's online twenty-four hours a day right at her desk in her dorm room.

Student and Mentor Concerns

For both students and mentors, the biggest concern was time constraints: Eleven mentors (five at Company 1 and six at Company 2) said they were concerned about finding enough time for email correspondence in an already-busy schedule.

> Grimsby: Probably a couple of hours in a week would not be a big deal. It starts getting more than that, then you start … getting into more practical time.

> Thompson: I could fall into the trap of not being real proactive about contacting them and just general chat, because I generally don't have that much time for general chat, right?

Interestingly, while four mentors at Company 2 worried they would be too busy, two thought they would have to monitor themselves to keep from spending *too much* time communicating with their students.

> Waldheim: I like to talk and because I get very enthusiastic about things, I have a, you know, there is a bit of concern on my part that I may allow this to snowball and start taking up large portions of my time. I want to be an active participant, but at the same time I don't want this to become a time drain.

Students offered varying estimates of how much time they expected to be able to dedicate to the program, ranging from one to two hours a week to at least an hour a day. Concern over the time commitment was also expressed by the students (five at Rural University and three at Urban University).

> Ingram: I'm doin' research and I got 17 hours (of) other classes; I'm involved in a lotta stuff. The challenge is probably find time to actually sit down, you know, e-mail my mentor … actually have ordinary conversations.

Three mentors at Company 2 thought students might ask them things they didn't know or couldn't remember, but they were confident that they could find the answer. Three mentors at Company 1 worried that students would want to be tutored, and they did not want to take on this role:

> Jackson: I would prefer not to get a lot of specific technical questions, because I do feel that's the job of their, their – [laugh] faculty members to help with that sort of thing. Uh, and besides, I think that, you know, probably the faculty's better equipped to handle those questions anyway, since they're the ones who are teaching the particular subjects.

Technology was less of a concern. Only a few mentors (two at Company 1 and three at Company 2) and a few students (two at Rural University and three at Urban University) said they were concerned about technology skill level or the effectiveness of the technology. One mentor was nervous because she had no experience with computer chat and one student was concerned because she didn't have Internet access at home. Another said she didn't like how much modern society depended on computers in general:

> Invergordon: I don't like computer technology very much. I, we have two computers in our home, and I use it only when I have to. … I hate the fact that technology is such an important part of our lives. … You know, all we need is a nice power outage and we don't know how to function.

Some participants had concerns about the communication process itself. One mentor was concerned that her student and she may not communicate as much as she'd like, and another wondered about what the pairs would talk about. Three students wondered if it would be a challenge getting started, and another worried about sustaining enthusiasm throughout the program. Several participants worried that the medium itself would hinder communication:

> Albertson: There's nothing like that, you know, one-on-one contact, you have the person there in person. … just being able to see their expression, you know, on certain issues or questions that I might have.

Others expressed concerns about the mentor-student relationship itself. Three mentors at Company 1 worried about the nature of the relationship they would have with their students or about getting to know them. One Rural University student wondered if mentors would truly be interested. One expected his student to be shy:

Quest: They're probably pretty tied into their friends' circles, their teachers and now, suddenly, I'm this person who's coming from an unknown place who they, they've never seen, so they would not probably know what to expect of me in the beginning. And the same way, I will not know what to expect of them at the beginning. So the time it takes to build trust, there probably will be shyness.

Interactions between Students and Mentors

Amount of activity. There was considerably more activity in the Spring 2000 forums (Urban University, Company 2, 647 total messages exchanged) than the Fall 1999 forums (Rural University, Company 1, 348 total messages). The two sets of messages are broken down by sender and recipient in Tables 12 and 13.

Table 12. Messages posted Fall 1999: Rural University/Company 1

	Recipients					
Senders	Mentors	Students	Faculty	Facilitators	Everyone	*TOTAL*
Mentors	3	80	3	10	1	*97*
Students	78	23	21	6	6	*134*
Faculty	4	19		17		*40*
Facilitators	18	22	11	14	9	*77*
TOTAL	*103*	*145*	*37*	*47*	*16*	*348*

Table 13. Messages posted Spring 2000: Urban University/Company 2

	Recipients					
Senders	Mentors	Students	Faculty	Facilitators	Everyone	*TOTAL*
Mentors	11	239		24		*274*
Students	182	74	12	29		*297*
Faculty						*0*
Facilitators	20	35	3	2	16	*76*
TOTAL	*213*	*348*	*15*	*55*	*16*	*647*

Not surprisingly, the mentor-student pairs saw the most message traffic. Company 1 mentors sent 80 messages to Rural University students, and Rural University students sent 78 messages to their mentors. At Urban University/Company 2, mentors sent 239 messages to their students and students sent 182 messages to mentors. Also at Urban University, two mentor-student pairs continued their correspondence on the Web-based discussion forum after the program's formal cutoff date (May 15, 2000). One pair exchanged 22 messages and the other exchanged 35 messages after the program formally ended.

Also not surprisingly, mentors tended to send longer messages than did students; the mentors' messages were approximately 60 words longer, on average. The mean message length for mentors was 168 words at Company 1 and 158 words at Company 2; the mean message length for students was 101 words at Rural University and 97 words at Urban University.

The two participating faculty members had quite different posting patterns. During Fall 1999, the faculty member at Rural University posted a number of messages to students and also to the facilitators. (In addition, this faculty member hosted study sessions using the chat function in the Web site.) During Spring 2000, the faculty member posted no messages on any forum, though class materials were made available on the Web site. In addition, several students reported in the post-semester interviews that this faculty member actively encouraged them

("hounded" them, in the words of one student) to participate in their own discussions with their mentors.

The facilitators posted more messages than they received, with about the same level of activity in each semester. The facilitator postings were distributed among mentors, students, and the forum available to everyone. These postings served several of the purposes suggested by O'Neill and Harris (2000), such as providing answers to procedural questions and keeping communication flowing throughout the program period.

The message posting activity by mentors and students was not evenly distributed over the course of each semester. Figure 2 illustrates the total number of messages per day posted by students and mentors, over the course of the four month program. These results resemble those found by Harris and Jones (1999), though in their study of the Electronic Emissary Project in spring 1993, the peak activity was in the second month of the semester.

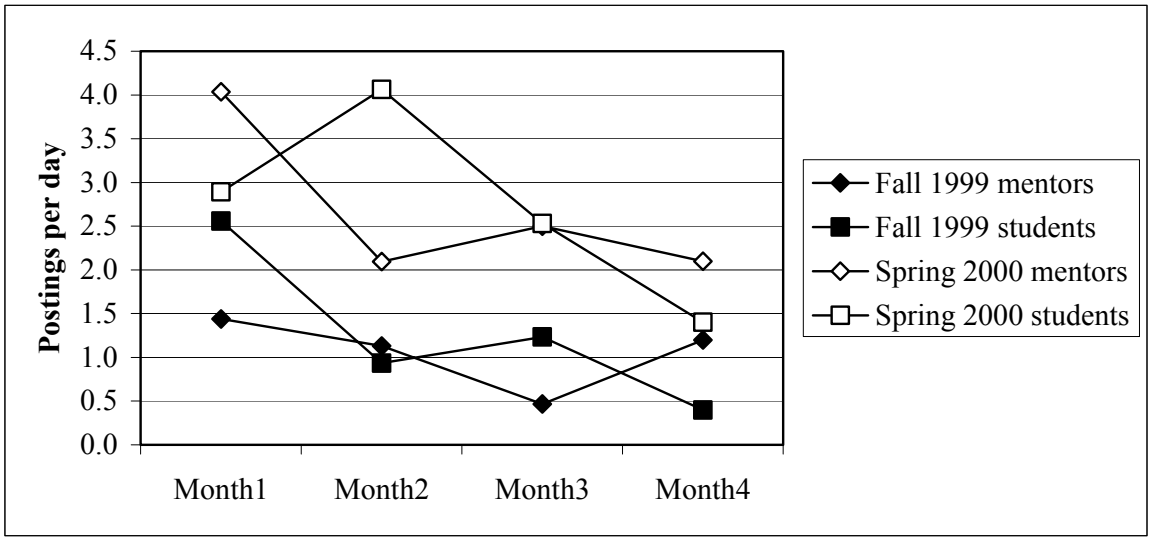

Figure 2. Messages posted per day, by students and mentors

During the first month, the students at Rural University (Fall 1999) posted more messages than their mentors. During the remaining months, the students lowered their frequency to more closely match that of the mentors. During the first month, the mentors in Company 2 posted more messages than the students at Urban University; during the second month, they reversed their activity levels; then they both decreased their activity in the third and fourth months. Throughout the program, there was more activity in Spring 2000 than in Fall 1999.

Interactivity. In a Web-based discussion forum, such as that used for this program, messages are connected in threads. A thread is a set of messages bound together by the fact that one message is a reply to a previous message, analogous to a conversation in face-to-face communication. The interpretation of a message as a "reply" may be based on the sender's use of the software-based reply function (i.e., the user clicks on the reply button to compose and post the message) or on the content of the message (i.e., the content of the message quotes or otherwise responds to content in a previous message). The threads in the *E-Mentoring* forums were analyzed using each of these two interpretations.

In order to understand the interactions among the project participants, it is useful to examine the threads within each forum. For an electronic mentoring program, it is most important to look at the interactions between the mentor-student pairs (see Table 14). Before discussing the results of this analysis, it is worthwhile to examine the contrast between the analysis based on the software's reply function and that based on the message content. The content-based analysis found fewer threads per forum, with the average thread length being somewhat greater. This result would indicate that there were instances where the student or mentor *should* have used the reply functionality of the software, but didn't (i.e., the content indicated that a message was a reply to a previous message, even though the software's reply function was not used to post it). During Fall 1999, there were more single-message threads based on the software's functionality than there were when the analysis was based on the message content, as would be expected from the previous analysis. In Spring 2000, this order was reversed: there were slightly more single-message threads in the content-based analysis. This indicates that some of the participants in the second pilot study were over-using the software's reply function.

Table 14. Activity in forums for mentor-student pairs

	Based on reply function		Based on content	
	Fall 99	Spr 00	Fall 99	Spr 00
Average number of messages per forum/pair	13.08	28.14	13.17	28.14
Average number of threads per forum/pair	6.92	8.71	4.58	8.50
Average number of messages per thread	2.11	3.56	3.01	3.57
Longest thread, overall	7	16	10	16
Average number of messages in longest thread	3.92	8.00	5.58	8.50
Average number of single-message threads	3.00	2.93	1.25	3.21

Based on the assumption that the content-based analysis is a better representation of the users' actual interactions, it will be used to compare the results from the two pilot studies. Overall, there were more messages per forum (as described above), there were more threads per forum, and message threads tended to be longer in Spring 2000 (Urban University/Company2). Even so, there were more single-message threads in the Spring 2000 forums, as well. It would appear that, in the spring semester, some initial postings generated long dialogues and others did not generate any response, while in the fall semester, most postings generated a small amount of dialogue. The interactivity maps in Figures 3 and 4, typical of those generated in each semester, will illustrate this contrast. Figure 3 represents the Fall 1999 forum for Dawn Kearns and Dave Logan. While it contains one long thread, it contains many short threads and only one single-message thread. Figure 4 represents one of the Spring 2000 forums, between Simon Lewis and Moira Thompson; it has several long threads, but also contains six single-message threads.

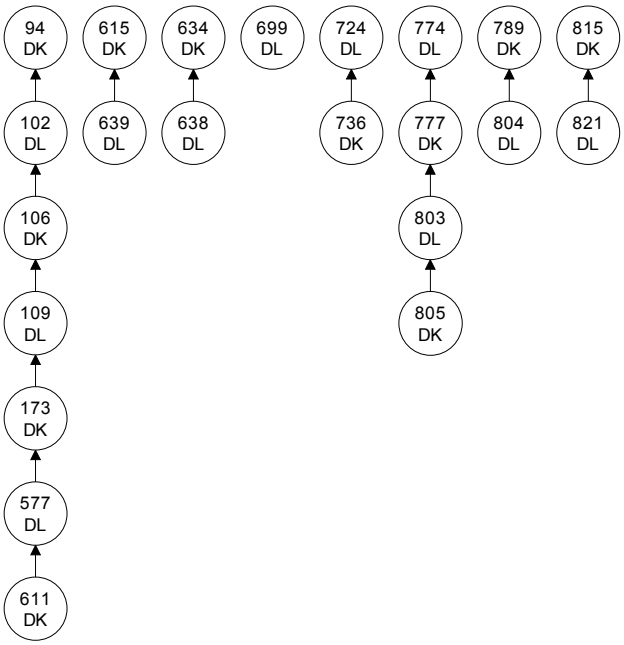

Figure 3. Sample interactivity chart, Fall 99

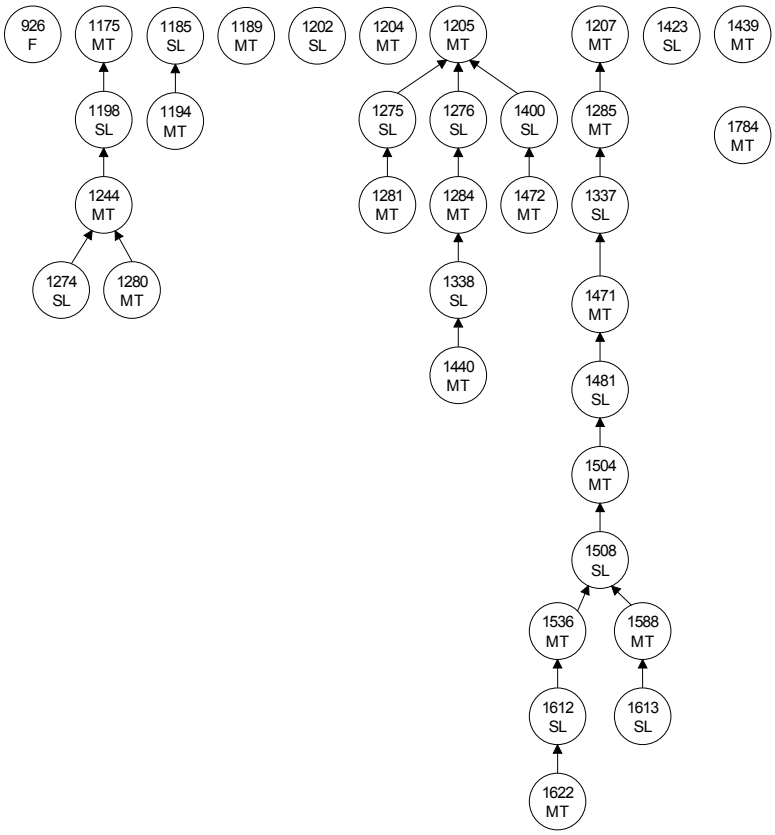

Figure 4. Sample interactivity chart, Spr 00

Group forums. There were three main group forums: one for students only, one for mentors only, and one for everyone. In the group forums, there was very little difference between the analysis based on the software's reply function and the analysis based on content, so only the content-based analysis results are presented (see Table 15).

Table 15. Activity in group forums

	Fall 99	Spr 00
Students-only forum		
Number of messages	30	97
Number of threads	7	26
Average number of messages per thread	4.29	4.04
Longest thread	13	11
Number of single-message threads	1	5
Level of participation*	100%	67%
Mentors-only forum		
Number of messages	10	17
Number of threads	8	6
Average number of messages per thread	1.25	2.83
Longest thread	3	8
Number of single-message threads	7	3
Level of participation*	22%	67%
Everyone forum		
Number of messages	16	9
Number of threads	9	6
Average number of messages per thread	1.78	1.50
Longest thread	7	3
Number of single-message threads	7	4
Level of participation*	29%	13%

* Level of participation = the proportion of eligible study participants who posted messages to this forum

Of the group forums, the Students-only forums were the most active in both semesters. The patterns of threads in the students-only forums were more complex than in the mentor-student pairs forums, as would be expected in forums that involved more participants: the number of messages per thread was greater, some threads were quite a bit longer, and there were few independent statements that did not receive responses. These patterns more closely resembled those found in class forums by Hara, Bonk, and Angeli (2000) than they did those that occurred between student-mentor pairs in this *E-Mentoring* project.

Particularly in the Fall 1999 semester, the students used the Students-only forum to get to know each other better and establish relationships with their peers:

> Ingram: Some of the people that I thought were kind of snobby turned out to be real good friends and then we worked together, you know.

Several Rural University students mentioned this increased interaction between the students during the post-semester interviews. Two Rural University students cited the advantage of participating in online study sessions, both with other students and with the professor (a few online chat sessions for exam preparation were organized and conducted by the professor). This type of study group helped one student answer questions she didn't get answered in class.

In both semesters, the Mentors-only forum and the Everyone forum were relatively inactive, with generally low levels of participation (the high level of participation in the Spring

2000 Mentors-only forum can be attributed to one thread initiated by a question from the facilitators).

Our analysis of the interactivity within these forums concludes with an examination of all the postings, each coded as one of the following (based on Henri, 1992):

Independent statement: a posting that initiates a thread; it does not explicitly or implicitly reply to any previous message;

Explicit reply: a posting that is directly linked to a previous message; for the software-based analysis, this code was operationalized as messages posted with the use of the software's reply function; for the content-based analysis, this code was operationalized as any message that explicitly refers to a previous message, e.g., quotes from it, or any message that implicitly refers to a previous message and is posted via the software's reply function;

Implicit reply: a posting that implicitly refers to another person or message, and is not posted with the software's reply function.

The frequencies with which each type of participant posted each of these types of messages are provided in Table 16 (Fall 1999) and Table 17 (Spring 2000).

Table 16. Types of messages posted, by sender, Fall 1999

	Mentors	**Students**	**Facilitators**	**Faculty**	***Total***
Based on reply function					
Independent statements	43	67	50	19	*179*
Explicit responses	54	67	27	21	*169*
Implicit responses	0	0	0	0	*0*
Based on content					
Independent statements	29	51	49	18	*147*
Explicit responses	67	81	28	22	*198*
Implicit responses	1	2	0	0	*3*

Table 17. Types of messages posted, by sender, Spring 2000

	Mentors	**Students**	**Facilitators**	**Faculty**	***Total***
Based on reply function					
Independent statements	103	77	42	0	*222*
Explicit responses	171	220	34	0	*425*
Implicit responses	0	0	0	0	*0*
Based on content					
Independent statements	94	80	42	0	*216*
Explicit responses	167	206	34	0	*407*
Implicit responses	13	11	0	0	*24*

One interpretation of the data in Tables 16 and 17 is to consider the independent statements as representing the initiation of new threads. In this light, this analysis would lead one to infer that the mentors' and students' participation was quite interactive, posting more responses than independent statements. The facilitators' role was quite different; often initiating a new topic but generally not participating in ongoing discussions. The faculty member (Fall

1999) seemed to take on a role somewhat in between, with about the same number of responses and independent statements.

During the post-semester interviews, the study participants were asked to comment on the frequency and nature of their interactions. The mentors generally responded quite positively to the experience. Five Company 1 mentors and four Company 2 mentors said they enjoyed the student interaction:

> Waldheim: To get on there and see a message from Sal[ly]. That was really neat.
>
> Vincent: For me, I would say it was fun... to chat with a student online. I don't get many opportunities to speak with students here. So I appreciated that.
>
> Jobe: I also liked meeting the kids… I enjoyed meeting by email the two young ladies that I dealt with: just kind of getting into their head a little bit.
>
> Grimsby: I guess the biggest thing would be just the interaction with students and trying, you know, trying to get involved, be able to help them get out of their, their problems and questions, whether it was school-related or otherwise. Just getting involved with other people, I enjoy doing that.

The students saw the program as more of a class assignment, so only occasionally saw their interactions with their mentors as "fun". However, their reactions to the interactions with their classmates were more often seen as pleasurable.

> Henshaw: It was just really crazy but I enjoyed it, I really did… being able to communicate with my classmates, we were like 'I don't know what we're supposed to be talking about, but OK we're going to try this', and it worked, and we'd come back to class the next day and we would just all laugh… so it was fun. It was really fun.
>
> Babcock: I wish everybody could have as good a time as I had. It **really** was good.

In spite of the generally positive comments, for some of the participants, there were various ways in which the actual experience didn't match their expectations. The biggest complaint from all the mentors and from six of the students at Rural University was that they did not have enough interaction, for a variety of reasons. Four mentors at Company 1 said there was less interaction than anticipated, either because the student didn't write much or because they were too busy themselves to write.

> Chen: I tried to write once a week, but it was hard. I mean, I had a note sitting on my computer and I would always say, "I'll do it today." And it would probably be Monday, and it would be Thursday before I would actually get a chance to look, and I would always feel guilty because she always replied that day and I never got around to rewriting until, like, the following week. I mean I was, I figure she must have been checking every day, so I was more disappointed in myself for not writing more.
>
> Logan: That's the biggest problem I can tell from my end is, is that I, I'll get engaged, this happened to be a very meeting-intensive year for me. So when I get loaded up with a lot of meetings, there's a lot of things going on, I'm…it can slip, it can almost slip your mind.

Because of the unsettled organizational climate at Company 1, taking the time to interact with the students was problematic for several of the mentors.

> Grimsby: I don't think it was viewed as a negative by management, but certainly, you know, they weren't clearing things off of our, you know, our plates to go and spend time doing this. I mean, this is a time you basically squeeze into what you're already doing. You know, if it's going to be

on a larger scale, there'd clearly have to be some buy-in from management to, you know, really, this is, this is a kind of an official project that we're, the company's doing.

Seven mentors at Company 2 said there was less interaction than anticipated, and some felt uncomfortable with initiating most of the discussion.

Vincent: Well, one thing that struck me is that I didn't feel particularly needed, really. … I would write, often times, and then it would be a long, long time before I would hear back. And I would try to -- a couple of times I would write a note saying, "Hey, are you there? Are you busy? Drop me a line when you get a chance." But I really didn't want to do that every time because I felt henpecky. And I know he's busy -- a student, and he's working in a job, and he's got his own personal life. … We were under the expectation that we'd be having running dialogue at least weekly, and when that didn't happen, you start thinking, "Well, is it my fault? Or is it his fault?" That just feels uncomfortable.

Vincent: I'm happy to be an avenue of information, but I think the thing that I disliked the most was the feeling of responsibility, that I'm supposed to be reaching out.

Setting expectations for the frequency of interaction seemed to be strongly related to success (as was suggested by O'Neill, in press). When the students' and mentors' expectations about frequency of communication differed, one or the other was often dissatisfied with the interaction.

Bushnell: We didn't communicate that much. I would e-mail her or post a message and she didn't, she didn't reply back to me. Sometimes (it would take) like a week, and then, I would, I guess I would expect a reply like two days or maybe two or three days, something like that.

One of the mentors at Company 1 commented that it would have been useful to have one phone conversation at the beginning of the semester in order to set up some clear expectations:

Mason: I kind of wish up front… that we were allowed to have one, maybe, telephone conversation with our student. It seemed in the getting-going part that I wasn't exactly sure when, you know, her access to, you know, I figured well, she doesn't have computer access on a daily basis. I wasn't quite sure when her access would really be, what were best times, you know, to try to communicate and things like that. And it just seemed to me that if we had been allowed one telephone conversation, we would have saved maybe a couple of weeks in saying, you know, what, what, is this good for you, or, you know, just saying some up front things of what we wanted to accomplish…

One student at Urban University, who had no complaints about the interaction, said she and her mentor did discuss their expectations and schedules at the very beginning of the program:

Henshaw: Our first conversation was like "OK, what is it you expect of me and this is what I expect of you." We laid that out in the very beginning and ever since then we've had nothing but good things. We also talked about our schedules. She told me what would be the best times to, for me to e-mail her and her to get right back to me, and I told her the same things. It was great. … If I had not done those things in the beginning, I think we would have had a problem.

However, the strategy of setting expectations at the beginning of the semester was not always successful:

Stone: I tried to set up a time when I thought my student would be there, like Monday, Wednesday, Friday, or are you going to be there from 9-10. And even though we tried that, it, it didn't really happen, I don't think.

For some of the participants, the mismatch with expectations was related to the content, rather than the frequency, of their communications. Four of the Company 1 mentors said they did not get the type of questions or interaction they expected.

> Rarek: I also found it tough to be cozy with someone I basically don't know. I know the suggestion was made to engage in casual discussions about my day and things. It's hard for me to do that. I'm better off if someone says, "I'm on chapter 11 and photosynthesis is killing me."

Three of the mentors at Company 2 commented on the lack of continuity in their interactions with their students:

> Ross: I mean I sort of anticipated that I would be able to develop and build an ongoing relationship, and that it would build after we got to know each other and it would build on itself, and so on. But it seemed like our communications were... came in fits and starts, and then there would be times when I'd realize that a week or two weeks had gone by and I hadn't even logged in to see if I had a message, much less provided a message for my student.
>
> O'Leary: I think I felt like we never had a continual conversation. We were always starting conversations. Nothing ever went anywhere.
>
> Waldheim: She'll ask me a question, and I'll answer her. Or she'll bring up a topic, and I'll respond to it. Then it won't -- I would like to see it develop into a discussion, and that never happens.

One mentor at Company 2 mentioned that requiring the students to participate may have been a disincentive:

> Quest: I think that [one of the reasons that] some of the matches that we had in our program here haven't been so successful is that the students were required to do this as part of their course… And a lot of them weren't terribly interested in doing it. And when they weren't enthusiastic about it, it, you know, tends to not go very well.

However, some of the students commented that having the program be a requirement of the course provided enough incentive for them to get started.

> Albertson: At one point I was about to say not make [the e-mentoring program] mandatory. Well, if it wasn't mandatory, I could honestly say I would not have done it. But because it was mandatory, I'm glad that, you know, I did it because, like I said, it helped me out a lot. But at the same time, if it wasn't mandatory—like, a lot of people say it shouldn't be mandatory—but if it wasn't mandatory, I know that I wouldn't have done it. I never would have done it.
> In the beginning I was not, you know, talking to my mentor, you know, and [our professor] got on me so I had to start talking to my mentor, and then, you know, I started getting into the forums and it became fun. … I was slow in starting because I didn't want to do it, to be honest with you, and after, you know, after we got into it, you know, it was cool.

In summary, the study participants were reasonably satisfied with the electronic mentoring interactions over the course of a semester. However, there were some problems experienced: difficulty in establishing mutual expectations about frequency of communication, difficulty in negotiating appropriate boundaries for the conent of the communications, and concerns over mandatory participation.

Perceptions of the Mentor-Student Relationship

The Quality of the Match. Prior to the beginning of the program, the research team did a thorough literature review to investigate the criteria that might be most useful in matching

mentors and students. Some past programs have used demographic characteristics, such as race and gender, as a basis for matching (some matching for the same race/gender and other matching for contrasting race/gender). For this study, race was not used as a matching criterion, since almost all the students were African-American and the mentors were either White or Asian. Gender was also disregarded, since prior studies have reported mixed results on the effectiveness of this matching criterion, and other interest-based criteria were deemed more significant to the possible success of the matches. The pre-semester profile form, filled out by the study participants, was used as the basis for matching students and mentors. This form (see Appendix A) asked about the science topics the participant was most interested in discussing, the career topics the participant was most interested in discussing, the participant's interest in biology, classes taken and enjoyed (students only), career plans/history, and personal characteristics such as hobbies, part-time jobs, and family. On the post-semester survey, participants were asked to rate the overall quality of the mentor-student match; their responses are provided in Table 18. All participants were neutral to positive about the matches. In general, the students were more positive about the matches than the mentors were (i.e., a higher proportion of the students rated the matches as good or excellent):

> Invergordon: I think you guys did a great job in terms of the match. I really think so. And like I said, he had lots of great information to share.

Table 18. Participants' perceptions of the overall quality of the mentor-student match

	Students		Mentors	
	Rural Univ, Fall 99	Urban Univ, Spr 00	Company 1, Fall 99	Company 2, Spr 00
Very poor				
Poor				
Neutral	3	2	4	5
Good	7	2	4	5
Excellent	1	4		1

Several students recommended trying to use the participants' schedules as a way to match mentors with students:

> Lewis: It's just... like if you can get on Monday, Tuesday, and you got a mentor who can get on... Well, if you can get on Monday, Wednesday, and you got a mentor who can get on Tuesday and Thursday, that would work perfect. Because they would able to write in between the days. You know, Monday in the morning is when I can get on, and Monday in the evening is when they get on, I won't read their messages until Monday -- see what I'm saying -- a whole week goes by.

One student suggested that mentors and students get to request each other, based on their own readings of each others' profiles:

> Albertson: I guess let us pick our mentors, like give us a profile… because we wrote our profile, you know, they got, they determined OK, let me pick this person because he wants to go in the field that I'm already in, you know because, say we have, like I know one of my colleagues, she wants to go to med school, you know, and say if there's a mentor who like maybe went through a MD-PhD, you know, I'm pretty sure she would probably want that person as a mentor. You know, so I think if, give the students a chance to read the profile, let the mentors read our profiles, then let us determine who we want to be with.

MentorNet has used a variation of this approach, where provisional matches are made but are subject to review by both mentor and student (Single & Muller, 2000). Such an approach was not considered feasible for the *E-Mentoring* program, since there were so few participants.

The Relationships between Mentors and Students. In the post-semester surveys and interviews, participants were asked about the quality of the mentor-student relationships. On the surveys, mentors were asked to rate their agreement with four statements about their students (using a 5-point Likert scale); students were asked to rate their agreement with parallel statements about their mentors. The survey results are presented in Tables 19 and 20.

Table 19. Mentors' perceptions of relationship with student

	Company 1, Fall 99		Company 2, Spr 00	
	Mean	*s.d.*	Mean	*s.d.*
My student(s) were interested in me.	3.4	*0.7*	3.7	*0.9*
I was comfortable answering my students' questions.	4.5	*0.5*	4.4	*0.5*
I am interested in continuing my relationship with my student(s).	3.6	*0.7*	4.1	*0.5*
I am interested in meeting my student(s) face to face.	3.6	*0.7*	3.9	*0.7*

Table 20. Students' perceptions of relationship with mentor

	Rural Univ, Fall 99		Urban Univ, Spr 00	
	Mean	*s.d.*	Mean	*s.d.*
My mentor were interested in me.	4.2	*0.6*	4.3	*0.5*
I was comfortable asking my mentor questions.	4.3	*0.5*	4.6	*0.5*
I am interested in continuing my relationship with my mentor.	4.2	*0.8*	4.0	*1.4*
I am interested in meeting my mentor face to face.	4.3	*0.6*	3.9	*1.4*

Note: Spring 2000, n=8

Overall, participants had generally positive impressions of each other. In some cases, the students had a more positive view of the relationships than did the mentors. In Fall 1999, the students were somewhat more likely to believe that their mentors were interested in them than vice versa ($t=-2.61$, with 17df, $p=0.0182$) and the students were more interested in face to face meetings ($t=-2.02$, with 17df, $p=0.0589$). In Spring 2000, there were no statistically-significant differences between the views of the students and the views of the mentors.

In describing their mentors, students at both universities used adjectives such as: funny, busy, outgoing, hard-working, nice, down-to-earth, chipper, family-oriented, helpful, quick to respond, intelligent and straightforward.

The majority of mentors (six at Company 1 and eight at Company 2) characterized their students as bright, focused, very busy people.

> Waldheim: She seems... pretty serious about -- we didn't engage in a lot of small talk. She would come to the forum with a question, and I would answer it, and that would pretty much be that. She seemed to use the mentoring relationship as a real -- very much as a means to get information. And so that sort of gives me the impression of someone who is serious -- just the facts, ma'am, kind of orientation.

However, two Company 1 mentors said they perceived their students as apathetic or as thinking the program was a bother.

> Grimsby: Well, the one student I haven't been able to contact … so whether that's lazy, too busy, I don't know, I don't know what the root causes of that are but they clearly were not interested in … giving it a fair shake.

Students and mentors characterized their relationship in different ways. Mentors typically described the relationship as professional or impersonal (five at Company 1 and six at Company 2), and were comfortable with that level of relationship:

> Jobe: I was glad nobody asked me about questions that I wouldn't answer. Like I don't answer questions about salary, or things like that. You know, we never really get into stuff that they should only be discussing with their parents. You know, we keep it at a level that's really good. And I think that uh, you don't get into any of the other stuff that's going on in your life, you know. You keep it at a professional level.

One mentor said she wished the relationship had developed further and blamed herself for not being more proactive:

> O'Leary: I might not call it a relationship even. … She would go in and ask the questions and I would try and answer them … It was very hard … (and the relationship felt) just a little bit antiseptic. A little bit kind of sterile.

Some students (four at Rural University and three at Urban University) described the relationship as similar to a student-teacher relationship where they discussed primarily science or didn't talk much at all. One described the interaction as "polite." Another said the program wasn't long enough to develop a personal relationship.

> Forester: I think it just depends on personalities, you know. If you are a really outgoing person then, you know, you'll probably go with relationships with anybody but-I mean, I am more introverted so I just didn't, I don't feel relationships that quickly, you know. What, a couple of months?

Some relationships, particularly in the second pilot study, reached a higher level of intimacy. One Company 1 mentor said she gave her mentor "sisterly advice." One Rural University student was pleased that a mentor offered not only specific information about chemical bonds, but also thoughts on how to juggle family and home life. Two Urban University students and four Company 2 mentors described their relationship as rather close or as friendship.

> Babcock: It's as if I know her! … We've been just talking. Just, just about anything. Just like a conversation face to face.

> Henshaw: I found myself, it was like "OK, did I get a message today?" … We were e-mailing back and forth the entire time, like three, four, sometimes five times a day. So it was great, and she shared so much information with me and I shared information with her. It was wonderful. I even got to meet her son online.

However, other relationships failed to gel. One Urban University student said she thought her mentor was speaking to her in a racist, patronizing way and didn't know it. This caused her to stop communicating with him.

> Invergordon: He said something like maybe his wife … had either read or heard of an African-American who had done something and so now they were going to go out and buy a book so that they could learn more about African-American history, whatever. And I wasn't sure why he felt the need to share that with me. … On at least three different occasions there was something like

this and I found myself getting irritated. And then I was no longer interested in talking to him after that.

In summary, most of the relationships between the students and their mentors were on a professional level, and that was satisfactory to both participants. In some cases, much closer relationships developed, but in a few cases, the relationships were unsatisfactory.

Impact on Student Participants

The participating students were asked about the effects of the program that they expected (pre-semester) and then, at the end of the program, the effects they actually experienced. Specifically, they were asked to select their top three choices from a list of possible effects. Their responses are presented in Table 21.

Table 21. Student perceptions of effects, compared with their expectations for effects

	Rural Univ, Fall 99		Urban Univ, Spr 00	
	Pre-semester	Post-semester	Pre-semester	Post-semester
Increased interest in science	3	6	0	2
Increased science proficiency	4	3	6	1
Improved grades	6	2	0	0
Enhanced career choices	9	6	7	3
Increased motivation to succeed at school	3	4	1	2
Increased self-confidence	1	0	0	0
Increased involvement at school	1	2	0	1
Increased use of technology	7	2	4	6
Developed friendship, personal relationship with mentor	5	7	4	5
Other	1	1	0	1

In Fall 1999, over half of the 11 students were expecting the program to introduce them to enhanced career choices, increased use of technology, and improved grades. By the end of the program, over half perceived its effects to be the development of a personal relationship with their mentor, enhanced career choices (as expected), and increased interest in science. In Spring 2000, over half of the 9 students were expecting to be introduced to enhanced career choices and to increase their science proficiency. By the end of the semester, over half believed they had increased their use of technology and had developed a personal relationship with their mentor. The "other" effects mentioned by students included: career facts, resources, and the comment that the question was not applicable.

Mentors were also asked, before the semester, what effects they expected to have on the students and, after the semester, what effects they believed they actually had. Their responses are reported in Table 22.

Table 22. Mentor perceptions of effects on students, compared with their expectations

	Rural Univ, Fall 99		Urban Univ, Spr 00	
	Pre-semester	Post-semester	Pre-semester	Post-semester
Increased interest in science	5	1	8	3
Increased science proficiency	1	0	3	1
Improved grades	0	1	1	0
Enhanced career choices	6	3	9	6
Increased motivation to succeed at school	3	1	7	2
Increased self-confidence	3	4	5	2
Increased involvement at school	0	2	1	0
Increased use of technology	2	5	3	3
Developed friendship, personal relationship with mentor	3	0	3	5
Other	0	3	0	4

In Fall 1999, over half the 9 mentors expected that the students would experience enhanced career options and increased interest in science. At the end of the semester, over half the mentors believed that students had increased their use of technology. In Spring 2000, at least half the mentors expected that the students would experience enhanced career choices, increased interest in science, and increased motivation to succeed in school. At the end of the semester, half the mentors believed that students had enhanced career options. In general, mentors' estimates of the effects of mentoring were less at the end of the program than they had been prior to the program's commencement.

Impact on academic performance and attitudes. Before and after the program, the student survey contained four items related to their attitudes toward their academic programs (see Tables 23-26). In general, the students' academic attitudes were high, and the program seemed to have little effect on them.

Table 23. Student responses to "Doing well in school is … to me."

	Rural Univ, Fall 99		Urban Univ, Spr 00	
	Pre-semester	Post-semester	Pre-semester	Post-semester
Important	10	11	8	8
Somewhat important	1			
Somewhat unimportant				
Unimportant				

Table 24. Student responses to "I feel I have … amount of responsibility for my own learning at school."

	Rural Univ, Fall 99		Urban Univ, Spr 00	
	Pre-semester	Post-semester	Pre-semester	Post-semester
A great	9	11	8	8
Some	2			
Little				
No				

Table 25. Student responses to "I feel … in my classwork at school."

	Rural Univ, Fall 99		Urban Univ, Spr 00	
	Pre-semester	Post-semester	Pre-semester	Post-semester
Very involved	9	8	7	7
Somewhat involved	2	3	1	1
Somewhat uninvolved				
Uninvolved				

Table 26. Student responses to "I feel I have the ability to pursue a career in science."

	Rural Univ, Fall 99		Urban Univ, Spr 00	
	Pre-semester	Post-semester	Pre-semester	Post-semester
Strongly agree	9	7	8	8
Agree	2	4		
Am unsure				
Disagree				
Strongly disagree				

Though the survey results did not indicate any impact on students' academic attitudes, a number of students reported (in the interviews) effects of the program on their knowledge of or attitudes toward science. For example, the interactions with her mentor provided one Rural University student with a better understanding of how different areas of science overlap:

> Moore: When I first got in there I was like OK, I'm a biology major, I'm trying to go into the field of biology, and my mentor is a chemistry major. But it was like, it just tied together so much. … So he taught me basically, you know, that it, you don't, just because you're labeled a biology major, that's not it.

One student at Urban University said the increased camaraderie probably improved her grade in the class:

> Henshaw: It was like you'd go in there (the site) everyday and you knew that by the time that you got out of class that somebody's going to e-mail you with something that happened in class today. … We, not only did we joke around but we really talked about a lot of the topics that were covered in class that we really didn't understand. We were like "OK, what was she talking about today?" and it was like "I don't know," I say "Well, hold on, I'll e-mail my mentor and I'll see what she says." But like, "Yeah, you e-mail your mentor and find out what she says, your mentor knows everything." So it worked. It was great, I really enjoyed it.

That student also talked about how much her mentor helped her by explaining specific scientific topics:

> Henshaw: A lot of things that I didn't understand in class, she really helped just open it up for me. We talked about DNA replication. We talked about translation and transcription and in a format that I would really be able to break it down and actually get it versus just me reading it in the book and having to decipher all these words. She's like "Look, these are the simple ways to remember it, this is it, just remember them, mRNA does this, does that and this."

This Urban University student also appreciated that her mentor shared relevant articles and books with her, in addition to providing valuable technical information.

> Henshaw: She shared a lot of different books that were not even class related, they were just excellent, and I, I read them just upon her recommending them to me and they were great… She

gave me a lot of good avenues and good places to go in learning the actual anesthesia process versus the one that I was doing.

The students had mixed opinions about whether participation in the program had actually increased their skill level in science. Six Rural University and three Urban University students said it had, while five Rural University and three Urban University students said it hadn't.

In general, the mentors were not as positive about the impacts of the program on students' academic performance or attitudes. Eight mentors from Company 2 said their student's knowledge of science had not increased, had increased very little, or they didn't know. One mentor was disappointed that she couldn't answer a technical question her student asked:

> Waldheim: The only technical question that (Sally) asked me was a question about DNA replication, about which I know nothing! (laughs) So... I get out my twenty-year-old genetics book, and she's using words that aren't even in this textbook. And so... I don't think I … necessarily contributed to their knowledge.

Though five Company 1 mentors said their student's knowledge of science had increased very little if at all, one mentor-student pair did see a direct effect of his help on her grade in an organic chemistry class:

> Moore: My teacher would try to explain, explain, explain and then when I go to him (the mentor) on the Web, he just was like, look, just do this, take the little molecules or whatever, you know, and they were just like, Oh gosh, yeah, I got it now.

> Grimsby: I gave some suggestions on how to, how to view it and some of the tools that you use, you know, some hard models or computer models. I actually gave them sites they could log into to, you know, to do it on, on sites and that person answered back, you know, several weeks later, on the next midterm they had, you know, they started to understand a little better and did much better than the previous one. So that person, I think, actually benefited in the course work from, from some of the conversations.

In summary, students' comments would indicate that the mentors had an impact on some students' academic performance and attitudes, even though the survey indicated no general effects. Mentors were not as convinced of the benefits of the interactions, but did cite a few specific and concrete examples of academic benefits.

Impact on career decisions. Enhanced career choices was one of the effects that students expected (and received) from this program. The interviews corroborated students' emphasis on this outcome. Many students (nine at Rural University and five at Urban University) said one of the major advantages of the program was that they gained a different perspective on corporate research and the available career paths in corporate settings.

> Bushnell: I really didn't have a picture before I went in, you know, think of how a career would be.

At Company 1, five mentors described their impact in terms of passing on encouragement, confidence, motivation, direction, and information for the future. For example, one mentor counseled his student that she should consider using her knowledge of molecular biology for a career in the pharmaceutical industry:

> Jackson: I tried to impress on her that there really, right now, is a profound change going on in the pharmaceutical industry. I, I hope she got this message… I thought it was an important message because there is a huge glut of molecular biologists in the job market right now. … But

> if she goes into … the pharmaceutical industry and … approaches drug discovery from the molecular biological viewpoint, there's a tremendous demand for people in that area.

One mentor at Company 2 was particularly pleased that her student asked for advice on choosing between two summer internships:

> Waldheim: She had two very exciting opportunities, a chance to study neurology at NIEHS and a chance to do cancer research at Duke. And she asked me for my perspective about what... what she should think about when deciding which one to go for. So I hope I was able to contribute to that.

One Rural University student said she originally wanted to go to medical school to become a doctor but became interested in getting a master's degree in forensic science after her mentor asked her a variety of questions about the type of environment where she preferred to work. One Rural University student was pleased that a mentor offered opinions on job outlook, contacts, and new sources of information, in addition to help with a research project. Another Rural University student got his mentor's opinion on his resume. Students at both universities said they learned about the stress involved with juggling various projects.

The issue of whether to pursue a Ph.D. was important to several of the students. One student appreciated her mentor's willingness to go out of her way to answer questions concerning further graduate study:

> Babcock: There's sometimes when she herself doesn't have the information, but she will go and get it from friends, cause she hasn't done her Ph.D. She doesn't have a family. But she has spoken to her friends who have done both, and you know, trying to figure out how easy it is, how feasible, and you know, that kind of thing. So she's been, she's been a resource person. She's used her resources, too, to help me…

Students also appreciated the diverse backgrounds and experience of their mentors, and how that diversity could inform their own plans. One Rural University student said it was interesting simply "being able to talk to a person who has gone through school and is out doing what she wanted to do, even though what she's doing is not what I want to do." Even an Urban University student who didn't get along well with her mentor decided to do some research on genetics because her mentor was a geneticist:

> Invergordon: I figure regardless of what field I choose, if I go into medicine, if I go into research, I'm going to need to have some expertise in this field. You know, I'm taking a genetics class, why not take advantage of it. And so he was able to shed some light on a different aspect that I hadn't even considered.

Another student commented:

> Lewis: I got to get an opinion of somebody with a different background from me, as opposed to a black male.

One mentor commented that both mentors and students benefited from the differing points of view in the mentor-student pairs:

> Logan: It gives both the student and the mentor an opportunity to experience different ways of life. For instance, from a mentor point of view, it's nice to, it's pleasant to reminisce about, at least it made me reminisce about how things were when I was in undergraduate school. For the student, I think they learn, they perhaps learn how to interact via electronic media, how to interact with somebody in a professional setting.

One Urban University student explicitly noted the importance of "building a networking community between my mentor and myself, as well as (the university) and … the industry."

The undergraduates were more likely to agree that their knowledge of careers and the field had increased: six Rural University students said their knowledge had grown (compared to three at Urban University), while five Urban University students said their knowledge had stayed the same or changed only a little (compared to one at Urban University).

> Kearns: If anything, it's gotten, made me more determined because that's (chosen profession that she wanted to pursue even before program started) something I really want to do.

Mentors typically didn't view the relationships as having that much tangible impact on the students, even in the career options being considered by the students. Several mentors noted that students were much more focused on a particular direction than they had expected.

> Yu: I think I feel quite disappointed actually, umm, because I don't think that I've really been able to impact at all on umm, (Sienna's) knowledge or skills. To an extent I do get the impression, I think she's, she's pretty independent and I think she knows her research and she knows what she wants to do anyway.

Impact on technology use and skills. Both the pre- and post-semester questionnaires included the same questions concerning students' computer use and computer skills, so comparisons could be made to determine whether the program had an effect. The amount of computer use by the students is presented in Table 27. There was no difference in amount of use that could be attributed to program participation, though one Rural University student said she hadn't used the computer much before the program but was using it more often now that she had Internet access and an email address.

Table 27. Amount of computer use by students (hours per week)

	Rural Univ, Fall 99		Urban Univ, Spr 00	
	Pre-semester	Post-semester	Pre-semester	Post-semester
Less than 1 hour		1		
1-5 hours	6	6	2	4
5-10 hours	3	3	4	3
21-40 hours	2	1	2	1
Over 40 hours/week				

Students were also asked to report the two types of activities that represent most of their computer use, both at work/school and at home. Their responses are presented in Table 28. The Rural University students did not report much change in their work/school use of computers; at home, they did move toward class projects and email, rather than playing games. There were only minor changes in the Urban University students' use of computers, either at work/school or at home.

Table 28. Computer uses of students

	Rural Univ, Fall 99				Urban Univ, Spr 00			
	Work/School		Home		Work/School		Home	
	Pre-semester	Post-semester	Pre-semester	Post-semester	Pre-semester	Post-semester	Pre-semester	Post-semester
To play games	1		6	2			2	1
For word processing	8	6	7	8	5	4	5	4
For class projects	5	6	2	6	1	2	1	2
To use e-mail	7	7	3	5	3	3	3	4
To access the Internet	5	4	2	2	7	5	3	3
To do graphic design			1					
To design Web pages						1		
To do programming								
Other						1		

Finally, the students were asked to rate (on a 5-point scale) their skills in performing a variety of computer-related tasks. Their responses are presented in Table 29. Both groups of students improved their skills in using threaded e-mail discussions—the primary form of interaction used for communicating with their mentors and others in the program. In addition, the Urban University students showed a slight increase in their word processing skills, and increases of more than 1 point in using online chat and file transfer software (including the sending of attachments, as mentioned by one Urban University student in the post-semester interview).

Table 29. Computer skills of students (means and *standard deviations*)

	Rural Univ, Fall 99		Urban Univ, Spr 00	
	Pre-semester	Post-semester	Pre-semester	Post-semester
Create a word processed document on a computer	4.2 *(1.2)*	4.4 *(0.7)*	**4.3** *(0.7)*	**4.8** *(0.5)*
Send and receive e-mail	4.8 *(0.4)*	4.8 *(0.4)*	4.6 *(0.5)*	4.9 *(0.4)*
Search for information on the Internet/World Wide Web	4.6 *(0.7)*	4.7 *(0.5)*	4.5 *(0.5)*	4.6 *(0.5)*
Participate in online chat sessions	4.1 *(1.4)*	4.5 *(0.7)*	**2.6** *(1.6)*	**3.8** *(1.3)*
Participate in threaded e-mail discussions (i.e., use electronic bulletin boards)	**2.5** *(1.2)*	**3.8** *(0.8)*	**1.3** *(0.5)*	**3.8** *(1.0)*
Create or edit a World Wide Web site (using such programs as html, java, etc.)	2.5 *(1.0)*	2.7 *(0.9)*	1.8 *(1.0)*	2.4 *(1.5)*
Electronically send and received files by way of the computer (over a modem, the Internet/WWW, etc.)	2.6 *(1.3)*	3.0 *(1.2)*	**3.0** *(1.4)*	**4.1** *(1.0)*
Program a computer using a programming language (such as Fortran, C, C++) or a database language (such as FoxPro or Oracle, etc.)	1.4 *(0.5)*	1.6 *(0.8)*	1.4 *(1.1)*	1.4 *(0.5)*

Note: n=8 students for Spr 00
Correlated t-tests were used to compare the changes in students' self-reported computer skills. Those pre-/post-differences that were statistically significant (pc.05) are shown in bold face.

During the post-semester interviews, two Urban University students reported that the program increased or improved their computer interaction and usage.

Albertson: I use the computer more because I guess I didn't realize how much fun it could be. I feel that I'm better at it, also.

However, two other Urban University students said the program did not enhance their technology skills or interaction:

Invergordon: The conversations that I had within the student forum, I would have had anyway. … I think it's just because of the way that I am in my, in my personality. I'm more apt to deal with you face to face. So if I have a question about an exam, I'm more apt to come by your office and ask.

Changes in the mentors' computer skills were not assessed with the questionnaires. However, during the post-semester interviews, several of the mentors commented on the improvement of their (or their students') technology skills as a result of participating in the program. Two mentors said it increased their comfort and students' comfort with technology. One said she was more likely to explore different Web sites once she was on line for the *E-Mentoring* program:

Mason: I maybe used the Internet intermittently before and, you know, (the program) sort of forced me to get (more familiar with it).

Impact on Mentor Participants

The surveys did not ask about the effects that students had on their mentors; however, this question was raised in the post-semester interviews with both students and mentors. While three Company 2 mentors and five Company 1 mentors said their students had no impact or a very small impact on them, some students and some mentors could cite specific examples of the ways that students influenced their mentors.

Sometimes the impact of the students on the mentors was quite concrete. For instance, one Urban University student helped her mentor with learning materials for her son:

Henshaw: I told her that I used to be a teacher and I sent her some things that I used in my classroom so she could use it for her son, and they worked.

However in most cases, the impact was more abstract. Three mentors at Company 2 said the program made them more aware of some of the issues that current graduate students face:

Ross: My E-Mentoring student had a family and was trying to balance studies and she was carrying a heavy load and had a lot of responsibilities at home as well. So it just gave me a little insight into what life is like for a student at a historically minority college. … My awareness of minority issues and education issues as they impact minorities was heightened. So I thought that was enriching for me. She's given me a window into her world, which I think may be... not drastically different, but somewhat different from my world. And so she shared enough of her personal life so that I think I got some insight that I didn't have before. There's more there -- I mean we didn't plumb the depths by any means -- but it was a start.

Quest: It's not like something … you read in a book or something that people told you … that students of age 22-24 years of old suffer from this agony of uncertainties. You have experienced it firsthand, even if it is just one email. And those will probably, probably stay with me. So it might help me later to appreciate somebody who is in a similar situation.

Waldheim: I think about Susie [who was deported] a lot. Just that it was too bad that things worked out for her like it did.

Five students at Rural University and two at Urban University also agreed that their mentors may have learned about today's students through the e-mentoring interactions. One student said she hoped she conveyed that students weren't just interested in partying but were "really trying to learn and build relationships with people." Others commented:

> Elkan: You know, I think it gave him the idea of what it's like being in my shoes, a junior in college again, you know, trying to make decisions, you're not sure if you're making the right decision … I know it has to be different from then. All kids my age aren't bad.
>
> Moore: I know he just realized there were some curious students out there because I always have questions.

Three Rural University students thought they probably made their mentors feel good about helping someone else:

> Early: (To) help a younger person who is trying to come up into the world, I think that probably gave her some satisfaction. I don't know. It would me.

One mentor said her student pushed her to do things she may not have done otherwise:

> Nordby: She's pushed me to go and find out things that maybe I wouldn't have done otherwise, which has been pretty good for me.

One mentor at Company 1 said his conversations with his student gave him the opportunity to reflect on his own position in his career:

> Markle: It's good to think about, that what applies to him applies to me.

Overall, it can be concluded that none of the students had a life-changing effect on their mentors. However, many of the mentors and some of the students generated examples of ways in which the mentors were positively influenced by their interactions with their students.

The pre- and post-semester questionnaires asked mentors about their use of computers. Their responses are presented in Table 30. During Fall 1999, one mentor moved from less than 20 hours of use to 21-40 hours, and one moved from more than 40 hours to 21-40 hours of use per week. In Spring 2000, most of the mentors moved from over 40 hours per week of use to 21-40 hours per week. However, during the interviews, three mentors at Company 2 said their technology use either increased or improved. It seems unlikely that the *E-Mentoring* program was the cause of any of these shifts in computer use.

Table 30. Amount of computer use by mentors (hours per week)

	Company 1, Fall 99		Company 2, Spr 00	
	Pre-semester	Post-semester	Pre-semester	Post-semester
Less than 1 hour				
1-5 hours				
5-10 hours	2	1		
21-40 hours	4	6	1	8
Over 40 hours/week	2	1	9	2

Assessment of the Technology/Software Platform

On the post-semester questionnaire, both the students and the mentors were asked about their perceptions of the Web site and World Wide Web, generally. Their ratings were based on a 4-point scale, from Strongly Agree to Strongly Disagree (see Table 31). Most respondents

believed that the Web site worked the way it should and was appropriate for the required tasks. The participants in the first pilot study did not agree that the technology was overrated, but the participants in the second pilot study did agree with that statement.

Table 31. Perceptions of technologies used

	Students		Mentors	
	Rural Univ, Fall 99	Urban Univ, Spr 00	Company 1, Fall 99	Company 2, Spr 00
They did *not* work the way they were supposed to.	3.1	2.3	3.1	3.0
They were appropriate for performing the tasks required.	1.8	1.8	2.0	2.1
They were overrated.	3.1	2.3	3.4	2.5

On the post-semester questionnaire, the students were also asked about the quality of the integration of technology into their coursework. Specifically, they were asked to compare their expected behaviors between a traditional course and the course augmented with the *E-Mentoring* program. Their ratings were based on a 5-point scale, from "much more likely" to "much less likely." Their ratings are reported in Table 32. At Rural University, participation in the program was associated with communicating with people from around the world, receiving detailed comments from the instructor and receiving those comments quickly, and discussing this course's concepts with the instructor. In addition, it was associated with feeling less isolated from both the instructor and the other students. At Urban University, participation in the program was associated with active participation in discussions about the course material, communicating with people from around the world, and discussing course concepts with other students. It can be concluded that, in each pilot study, the *E-Mentoring* program did have a positive impact on interactions within and outside the class.

Table 32. Student perceptions of technology integration (means and *standard deviations*)

How likely were you to…	Rural Univ, Fall 99	Urban Univ, Spr 00
…actively participate in scheduled discussions about the course material (such as an in-class discussion section or a computer forum).	2.5 *(0.8)*	1.9 *(1.5)*
…ask for clarification when you didn't understand something.	2.4 *(0.9)*	2.1 *(1.3)*
…communicate with people from around the world.	1.6 *(0.7)*	1.7 *(1.3)*
…discuss the ideas and concepts taught in this course with other students.	2.4 *(0.8)*	1.3 *(1.7)*
…work on assignments with other students.	2.1 *(0.8)*	2.4 *(1.5)*
…ask other students for comments on your course work.	2.3 *(0.6)*	2.3 *(1.5)*
…feel isolated from other students.	3.9 *(1.1)*	3.4 *(1.7)*
…obtain help understanding course material from students/peers who do not attend this university.	2.1 *(1.4)*	2.9 *(1.5)*
…miss comments made during a discussion about the ideas and concepts taught in this course.	3.1 *(1.4)*	3.3 *(1.6)*
…receive detailed comments on assignments from the instructor.	1.7 *(0.8)*	2.9 *(0.7)*
…receive comments from the instructor on the assignments quickly.	1.5 *(0.7)*	2.7 *(1.1)*
…tell the instructor when you have a complaint or suggestion about the course.	2.1 *(0.9)*	3.4 *(1.0)*
…discuss your academic goals and/or career plans with the instructor.	2.2 *(0.9)*	2.7 *(1.6)*
…feel isolated from the instructor.	3.9 *(1.1)*	3.4 *(1.7)*
…discuss the ideas and concepts taught in this course with the instructor.	1.9 *(0.8)*	2.7 *(1.4)*
…get to know people who are different from you in their cultural and socioeconomic background.	2.3 *(0.6)*	2.1 *(1.2)*

A second set of questions was also related to the integration of the technology into the two pilot study courses. They asked students to reflect on the ways that the program affected their learning and class interactions. Each question was rated on a 4-point scale, from Strongly Agree to Strongly Disagree. The students' responses are reported in Table 33. In most cases, the students from the two pilot studies had similar experiences. Both agreed that they put more thought into their comments, that they felt more comfortable asking awkward questions, and that they were better able to juggle their school and home responsibilities. In addition, the Urban University students felt more comfortable disagreeing with the instructor and spent more time studying. These responses support the conclusion that the *E-Mentoring* program had positive effects for these classes.

Table 33. Students' perceptions of technology use in the course (means and *standard deviations*)

Because of the way this course uses techology…	Rural Univ, Fall 99	Urban Univ, Spr 00
…I put more thought into my comments.	1.7	1.9
	(0.6)	*(0.9)*
…I feel more comfortable asking an awkward question.	2.2	2.3
	(1.0)	*(1.1)*
…it is difficult to relate to the other students in this class.	3.1	3.1
	(0.6)	*(1.4)*
…it is easier to work with someone from a racial or cultural background different from my own.	2.5	2.7
	(1.2)	*(1.4)*
…I waste too much time sorting through my messages to find the few that are useful.	3.0	3.1
	(0.4)	*(1.0)*
…I waste too much time communicating with others on topics that are not directly related to my course work.	3.0	2.6
	(0.4)	*(1.4)*
…I usually must wait a long time to use a computer.	2.8	2.9
	(0.6)	*(1.2)*
…I spent too much time learning how to use the E-Mentoring Web site.	3.3	3.5
	(0.5)	*(0.5)*
…I am better able to juggle my course work with my work and/or home responsibilities.	2.2	2.0
	(0.7)	*(1.5)*
…I put in less time traveling to and from the campus.	2.8	2.8
	(1.1)	*(1.3)*
…I don't receive responses to my comments.	3.1	3.6
	(0.6)	*(0.8)*
…I feel more comfortable disagreeing with the instructor.	2.7	2.0
	(0.8)	*(1.9)*
…I am at a disadvantage because I do not possess adequate computer skills.	3.5	2.9
	(0.5)	*(2.0)*
…I am at a disadvantage because I do not possess adequate typing skills.	3.5	2.9
	(0.5)	*(2.0)*
…I spend more time studying.	2.5	2.3
	(0.5)	*(1.5)*

Some comments in the post-semester interviews also addressed the effects of technology use on the course. For example, one said the faculty member's encouragement helped. (Students were given extra points for going onto the *E-Mentoring* site.)

> Early: It gets you more involved in a class and not so just going through the motions … It's like a twenty-four hour thing with this class. (The professor's) extra oomph to make us do it … made it possible for us to be more involved.

In addition to the communication tools, other aspects of the Web site were also useful for the study participants. Four Rural University and four Urban University students specifically found the online calendar and syllabus to be helpful, while one Urban University student liked the class directory. Two Company 1 mentors thought the profiles were helpful, and two Company 2 mentors thought the calendar was helpful.

Most students (10 at Rural University and three at Urban University) said they had no technical problems with the software or hardware. Five Rural University students mentioned one or two isolated incidents where the computer froze or would not allow immediate access, and one Urban University student said there was some slowness. Five Company 1 mentors and four

Company 2 mentors characterized the technology and Internet as easy and convenient. In general, the mentors experienced no real problems with the software or the Web pages except for an infrequent slowdown.

Advantages and disadvantages of the technology. The students and mentors participating in the program identified a variety of advantages of the technology, and almost every one has a complementary or accompanying disadvantage.

The asynchronous and geography-independent nature of the Web site was seen as an advantage by several students. Five Rural University students and four Urban University students said the technology gave them the opportunity to use the program from multiple locations and/or at any time that was convenient for them.

> Invergordon: I wasn't pressed to respond immediately. I could take my time and send a nice message and know in a couple of days he will have responded and there's no pressure on either end. You know, wherein if you make a phone call sometimes, you know, and you answer that phone you feel compelled to have that discussion at that moment. E-mail alleviates that stress.
>
> Babcock: A face to face encounter would have been more restricting. Cause I'm in the lab. I'm carrying out an experiment. I go on the computer. I send McKayla a message. I go back to what I'm doing.. In ten minutes or five minutes I come back, I check.. I respond and I..so it doesn't interrupt the flow of my activities.

The flexibility allowed by being able to post a message at any time was offset by the (potential) delay in receiving a response. Two Company 1 mentors and one Company 2 mentor mentioned this problem with the asynchronicity of email, while three Rural University students indicated that they *expected* quick responses.

> Grimsby: There's always a delay. So that, you know, if you're working on your homework assignment … that's due the next day, you know, this is not something instantly that they can … get a question to us and get a response back in time … to be useful … for an urgent need.
>
> Ingram: The advantage is it's quick. … unlike calling someone on the phone or sending a letter. It's like you can get an answer within five minutes, two minutes.

Two mentors, one at each company, commented on the efficiency of CMC for mentoring. They found electronic mentoring to be more time-efficient than non-electronic mentoring.

> Markle: I was (able) to provide the type of advice of very high quality with very little expenditure of time – it's a very pleasant surprise.

Two Urban University mentors located in the UK had techno-distance problems. Quality of service on the Internet is not consistently high, and mentors found that logging onto the E-Mentoring Web site (whose server was located in the southeastern US) to send and read messages was often problematic during times of the day when US and US-European Internet traffic was heavy.

> Yu: I found the time distance quite frustrating. We can, we can log on in the morning and we can see stuff on the Web really, really quickly. And, and then by the time you guys wake up and take to work, which is about ooh, one o'clock in the afternoon. About one o'clock, two o'clock, THE WEB IS SO SLOW! That, that was quite frustrating, umm, you know finding that there were problems with the server or, or just slow network connections. It, it you would be amazed how much it slows up in the afternoon over here. Cause the volume of people using it.

Four Rural University students cited easy access to the Web. However, while the Web as a platform was an advantage for most participants, it put those without easy Web access at a disadvantage. For example, two Rural University students said it was a problem that they didn't have Internet access at home.

> Keyes: I have to make a special trip just to go to the computer lab and do it. It's just that time part. I mean, if I had the Internet in my house, it would be no big deal. I mean, I'd just hop on and make my statements and get off … It's just the competition on campus to get onto a computer…

Eight Rural University students said they were able to gather lots of information via the technology and program. Two Urban University students said the Internet gave them access to information they may not have gotten otherwise, such as information on finding internships.

> Babcock: Information that … you will have difficulty accessing the hard copy, it brings it right to your desk. Uh, it also, like pulls together information, like from sources that you might not have thought about. … It saves a lot of time, too, I find, because I can, I can umm, cut areas of documents, quotation stuff, and put in my article and I'm writing without having to go to the library to get a copy to type it out, that kind of thing.

On the flip side, the information dissemination role of the Web also led to some problems. Three Rural University students and one Urban University student experienced information overload, finding it a general problem when unwanted information was retrieved while searching online.

> Forester: Definitely, it is a wealth of information, uh- I guess, trying to get through all of the information, there are a lot of things that, you know, may just be junk.

Two Urban University students were worried about confidentiality and privacy, and expressed concern over the level of privacy available in the program. However, three Rural University students saw the privacy offered by the program as an advantage. Their comments illustrated the varying perspectives:

> Albertson: It just seems, I don't know, I guess, call it paranoia, but I'm thinking if I'm up there and I like, you know, and be e-mailing my brother or something and somebody else could read it.

> Moore: I like the fact that everybody can't go in there. You know, you have to have a password, that you can just talk to your mentor and nobody else knows.

The mentors identifed some additional advantages of the technology. For example, some Company 2 mentors said they preferred the Web-based, threaded discussion forums, even though email may have been easier. One Company 2 mentor liked the ability to reference old messages and the storage properties of electronic communication.

> Stone: Sometimes I would read what other people had written that I had access to. Or I'd go back to the, some of the early conversations I think. "Did we talk about-, let me go back and look at …" so I liked that! … I (also) liked it, the Web site you had … because I could see what had been read, what had not been read. And I guess with email you send it but it kind of goes in the dark hole and you don't know if it's been read.. So, with the umm, the application you had, I could go out there and say, "Okay my message still hasn't been read." But then that was actually de-motivating for me, because I wouldn't send another message, cause I'd feel like, "Okay I've got two out there in the hopper, do I send a third one?"

One Company 2 mentor said emails and discussion forums gave participants time to think before responding. Two Company 1 mentors even said the impersonal nature of email was good for this program.

> Markle: There's the impersonalness of it … but I actually think in this case that that's an advantage. Here it was a strictly professional interaction. You know, whatever personal comes into it is still impersonal. Even the personal information is carefully edited before it's transmitted.

One Company 2 mentor also focused on the enhanced communication made possible by the technology. In particular, he felt that it was useful for shy people to be able to compose their messages before sending them. (Interestingly, the technology was also beneficial for a deaf mentor, who was very accustomed to communicating in writing.)

> Quest: It has the power of opening up introvert people. You will find people who are introvert who don't like to talk in public, you know, or shy, they might, they might do just fine when they are given a computer. … For somebody who prefers to write more than to talk, this is the way to go. The advantage is that since, since you're writing … you've got time to think about what you're going to say, compose yourself, compose what you want to say.

However, not all participants felt that CMC was as effective as face to face communication. Three mentors at Company 2 said it was hard to establish a rapport or relationship via email, and three mentors at Company 1 and one at Company 2 commented on the lack of visual cues, noting that CMC was not as rich as face to face communication.

> Logan: Since I'm a visual person, I, I often communicate by visuals rather than verbiage. It's a little more challenging for somebody like myself.

> Jackson: I really have only one criticism and it's this: When you talk to someone face-to-face, you can tell just by looking at the other person if the body language, the look on the face, the look in the eyes, you can tell when you're communicating effectively, when you're getting across and when you're not. Obviously, on a computer you cannot do that.

> Stone: I would say as far as the frustration goes that I think it's difficult to develop rapport on email. And a face to face meeting would be essential for me to participate in an activity like this again.

One mentor at Company 2 was even more focused in her comments on the inferiority of CMC, emphasizing the need for richer communication in order to establish new relationships such as were expected in this program.

> O'Leary: (It reinforced my belief that if) you're going to truly influence someone … you need to do that uh, face to face. You need to have a really established relationship that you have. You can do it electronically if you've got the established relationship first. Cause then you're building on something. But to establish the relationship electronically, it, it, it's very, very hard to do. …

Both the mentors and the students also commented on the effects of CMC on the mentoring relationship, specifically. Rural University students did not note any major differences between other mentoring experiences and the *E-Mentoring* experience. They said it was similar but without the face-to-face interaction. Two Urban University students noted that computer mediation made the experience different, while another described electronic mentoring as more flexible, in that it allowed participants to set the limits on their own relationships. The Urban University student who stopped communicating with her mentor said face-to-face interaction might have saved their relationship:

> Invergordon: I just have to say I just felt like he was being very ignorant. And maybe if he had an opportunity to meet me and talk to me, then that would have helped.

The mentors were more critical of the overall electronic mentoring experience. Four mentors at Company 1 and five mentors at Company 2 said they felt electronic mentoring had some aspects that were less fulfilling than face-to-face mentoring.

> O'Leary: (One of the most) fruitful experiences I've had mentoring is when I was actually showing someone how to do a technique in a lab.. (It might be better to train mentors) in some way to, to get that credibility as a mentor. Otherwise I think you're just a person on the other side of a PC.

One Company 2 mentor commented that computer-mediated mentoring took considerable effort. Interestingly, another Urban University mentor said just the opposite:

> Pavlova: I would let them know that it takes very little time to do this program, which is nice about it.

One Company 2 mentor said the program felt contrived because it was limited to electronic communication:

> Thompson: We were only expected to interact with people through the software and not necessarily to call them or to see them or things like that. And so, because of that constraint, I felt like it was a contrived situation and that, to me, isn't as nice as if it had been one part of, you know, an interaction.

However, one Rural University mentor said he was now convinced the technology would work for this type of program:

> Markle: It works better than I would have expected... the quality of the interactions, very insightful questions, and the facility of the question-asking. I think that the whole idea of the electronic mentoring is very good, and a better tool than I had thought going in, for the intended purposes.

One technical difficulty that caused problems in program implementation was the fact that WebCT, the software platform on which the *E-Mentoring* Web site was built, had limitations on notification of forum members when new items had been posted. As a Web-based discussion forum, this technology could be characterized as "pull", in contrast to email which could be characterized as "push". Because the activity levels were fairly low, a critical function of the software was to notify participants when something new had been posted. In WebCT, the only capability for this function was to notify every participant when *any* message had been posted in any forum (a functionality that is appropriate for class-based discussion forums, but not for the private mentor-student forums we implemented). Two mentors in Company 1 noted this problem:

> Markle: I think I spent more time checking for his responses than anything else. Which, of course, starts to feel like a waste of time.

During the second pilot study, this problem was remedied by having a member of the research team individually send email notifications to each participant whenever a message had been posted in a forum of which they were a member.

The most significant technical problem faced by the mentor-student pairs involved the use of the online chat feature of the Web site (see Figure 1). In both Company 1 and Company 2, the corporation's firewalls blocked the use of IRC (chat) for security reasons. In neither case

was this problem resolved during the course of the pilot studies. It was possible for mentors and students to schedule synchronous chat sessions if the mentor was willing to connect from home or some other location, but chat sessions could not be conducted by the mentors from their offices.

There were a few other less significant technical problems. Two mentors at Company 1 didn't like the fact that their own postings showed up in their forums as unread. Two mentors at Company 2 said that having to go into a Web-based system, in addition to their normal email system, was a disadvantage. Two Urban University students and two Rural University students said the URL or password was too long and hard to memorize.

Evaluation of the Kickoff Event

At the beginning of each semester, a kickoff event was held, as described in the previous section and in Webster et al. (2000). In Fall 1999, the students were gathered in a computer lab on campus; due to a recent hurricane that caused some corporate closings, the mentors were located in several places, including their offices and homes. In Spring 2000, the students were gathered in a campus computer lab, and the mentors were gathered in a training facility at the corporate offices or in an office in the UK. In both cases, all the study participants were online simultaneously. Special discussion forums were set up within the Web site, for the event.

The kickoff activities began with a series of questions/threads designed to allow the participants to get to know each other informally. Example stimulus questions included:

> Does anyone have a pet that isn't a cat or a dog? What kind of animal? What's its name?
>
> Do you speak any languages besides English? Which languages?

The participants were invited to respond to as many of these threads as they liked, and were asked to read the responses of others. The group spent about 30 minutes on this activity.

Next, the participants were formed into four teams, each including a few mentors and a few students. The teams were given problems to solve (Webster et al., 2000). During the Fall 1999 kickoff, they worked on a problem related to science; in the spring, a second problems was added, related to a career decision. They were allowed about 30 minutes to discuss each problem. At that point, the student-mentor pairs were encouraged to enter their own forums and discuss possible correspondence times:

> Facilitator: At this point, please go to your individual student-mentor forum and "speak" with your mentor/student. Try to figure out what times will be convenient for you to correspond.

Each kickoff event lasted about 90 minutes. During the event in Fall 1999, 383 messages were posted; during the Spring 2000 event, 249 messages were posted.

During the post-semester interviews, students and mentors were asked for their impressions of the kickoff event and gave mixed reviews. At Rural University, the students were quite satisfied with the experience. Seven students offered only praise and said they would not change anything about the event. Eight students said they enjoyed the interaction, four said they enjoyed working on the problems and the creativity of the event, two saw it as a chance to get acquainted with the project, and three said it was fun. Four mentors from Company 1 described the kickoff as fun because it gave them a chance to interact with and learn about students, to break down barriers.

Grimsby: … people had fun, had fun. I know, at least in our group, we were having a lot of fun on our side. I can't say exactly what's happening over on their end. I thought it was good. You know, you get to learn some things about the people and so forth and I thought that's very beneficial.

Mason: The get-to-know-you part was kind of fun. I mean, I know people were writing all sorts of, you know, crazy things in there. … You sort of got people's sense of humor in there.

Complaints about the Fall 1999 event were individual in nature. Students suggested that all mentors should be online during the event; that the event should include more personal information; that it should be longer; and that it took too long to get started. Three Company 1 mentors said the kickoff event didn't establish the purpose of the program well enough. Two said the problem-solving exercise was too long or may have been intimidating.

The Spring 2000 kickoff event was praised by six mentors and two students. One student commented that it helped him understand the purpose of the program, and two said it was good for training. One of the students pointed out the necessity of some type of event for getting acquainted; the mentors' reactions were similar to those of the Company 1 mentors.

Lewis: It helped break the ice. And that's necessary. It is necessary 'cause I couldn't imagine me getting on, you know, right -- just talking to my mentor.

Henshaw: It gave us all an opportunity to bond, to really learn how to use the program. … It was a great atmosphere. It wasn't a straight business, business atmosphere.

Yu: It was a great way of getting to know the Web site and how it all works.

Waldheim: Oh, I loved it. I had a blast.

The Spring 2000 kickoff event did draw several critical comments. Three students criticized the kickoff questions for being boring, not personal enough, too narrow, and too time-consuming. One suggested including more "getting to know you questions." Another suggested using "more mature" questions for graduate students than for undergraduates.

Invergordon: There were too many questions. And so I spent so much time answering some of those dumb questions that I didn't get a chance to properly introduce myself to my mentor. So that whole aspect was lost.

Three students said the kickoff event was rushed or too short. Three mentors said the event ended before they could get everything done. (It should be noted that the Spring 2000 event was a little delayed in starting, because some of the mentors arrived late.)

Waldheim: I felt like we were rushing through it a bit. But it's a tradeoff, because they had to get to class. It's hard for us to carve more than a two hour block of time -- well, one and a half to two hour block of time -- out of our day without feeling like "Oh, gee, I've got all this other stuff I need to do."

Two mentors felt that the students may have been intimidated, and three said there was not enough one-on-one interaction with students.

Yu: The mentors were obviously and the facilitators are obviously very familiar with using email, and using the Web sites … It just seemed apparent that there were very few messages that were coming in from the students themselves. So I hope that didn't put them off too much.

One student believed the event was not structured enough, which meant people were not doing the same thing at the same time, which wasted time. One mentor said it was too drawn out with irrelevant information.

> Thompson: The explanation about the whole program was a little bit long and drawn out and could have had more meat to it.

Overall, it can be concluded that some type of event is necessary in order for the program to begin successfully. Our informal getting-acquainted exercise was a successful way for mentors and students to feel more relaxed in communicating with each other via the Web-based forums. The problem-solving exercises were also useful, but their content and timing may need improvement.

General Reactions to the Program

Many students (eight at Rural University and four at Urban University) said they would like to participate in the program again or would like to continue interaction with their current mentor.

> Henshaw: Definitely. Maybe one day I'll be a mentor.

Several said they had established a friendship or the beginnings of professional networking, and the program had opened their eyes to different ways of establishing a bond.

> Albertson: It helped me to learn that there are other ways of communicating instead of like one on one contact … you know, in person.

In addition, most students (10 at Rural University and four at Urban University) also said they would recommend the program to others.

> Lewis: They don't teach you everything here at school. So … any means of getting the... extra information is a plus.

Two students said they would recommend it only if mentors and students were from common fields or there was more interaction. Another suggested that the program be expanded to include younger students:

> Henshaw: I was thinking more of like maybe the high school level, to give people an opportunity to see "OK, is this really a field that I'm really interested in, what does this person do all day?"…

Three Urban University students did not like the mandatory nature of the program, but another admitted she wouldn't have participated if it had not been required and another saw no problem with the requirement.

> Babcock: Maybe you can get something out of it unexpectedly. It's an opportunity I think that you shouldn't let go by. I mean, making it compulsory doesn't take anything from you. And you never know, you may come across something that will last you a lifetime. It's a good experience.

Urban University students offered a variety of reasons for not wanting to participate further. The student who stopped communicating with her mentor said simply:

> Invergordon: I don't think there would be much more to be gained.

One said it was difficult to talk to someone you don't know, another said timing was difficult, and one student didn't like the notification messages. Four students objected to the researchers' ability to access all the forums, and desired more privacy:

> Albertson: I think there should be a way that you guys could, like, assess whether or not we're using the program, you know, the e-mentoring without necessarily knowing what we're reading or writing.

Two Urban University students complained that the faculty member either constantly hounded them to participate or didn't check the forum often. One said there were lots of long forms that could be distributed more easily online.

In comparison, the vast majority of mentors (seven at Company 1 and nine at Company 2) said they would participate again, continue interaction with the students, or recommend the program to others. One Company 2 mentor already planned to meet with her student.

> Stone: We actually have a face to face meeting scheduled if the student's able to come this Thursday. … Our internships have already been filled for this year, but I told her if she would leave me her resume and I could introduce her to a few people, and I've actually worked with a few vendors who do contracting here, that it may be possible for us to set her up with some opportunities like that.

One Company 1 mentor said he would not recommend the program, but he would continue participation if the student wanted that. Two mentors at Company 2 would continue, but not in the electronic format only.

Participants offered a number of recommendations. First, several participants (four Rural University and two Urban University students; two Company 1 and three Company 2 mentors) suggested that the program be lengthened, keeping the Web site up longer or, in general, making the timing more flexible, so students can continue with another mentor after the semester is over.

> Jackson: It should be more than just one semester. I think it takes a long time to build up any trust… when you haven't even met the person and all you're doing is just exchanging a few little cryptic e-mails.

> Vincent: I think maybe you have to do something for a year instead of just a semester. Because the semester really flew by in no time, especially when somebody's only writing you once every week or two.

Several mentors (six at Company 1 and three at Company 2) suggested providing videoconferencing or teleconferencing. Videoconferencing was seen as a secondary choice by some because it was acknowledged as having some potential problems.

> Logan: A periodic videoconference would probably help…early on in the program. Once again, it has to do with how fast can you, I think, how fast can you build a relationship with a student so that discussion becomes much easier.

> Yu: I suppose we could have had a videoconference, but … those are quite inhibiting in themselves, to be honest, and I don't enjoy them very often. … They are pretty intimidating.

Several students (five at Rural University and three at Urban University) suggested that more effort be made to match students with mentors, to ensure better and more interaction.

> Albertson: Let us pick our mentors, like give us a profile.

> Kendrick: With those mentors who do have hectic schedules, let the students know beforehand … or try to get people who, who are not as busy … that will be able to respond to questions that students will have.

There were some suggestions for increasing the amount of interaction among participants. Some participants (three Rural University students, one Urban University student, and three mentors from Company 1) suggested that the program facilitators schedule discussion/interaction time, or in other ways add more structure to better "manage expectations" (three mentors at Company 2).

> Quest: Maybe in the absence of an expectation the students didn't know what to ask, what to ask their mentors about or what to even talk about. … It's like making sure that you know what I am going to talk about, or that you know what to expect from me, and I know what to expect from you.

One mentor suggested that each week a different mentor could "host" a live real-time chat with all the students. One mentor suggested that the kickoff event be repeated mid-semester and other participants (two Urban University students and two Company 2 mentors) suggested repeating it at the end of the semester:

> Thompson: (A closing event) would make for a more feeling of success in closure to the whole thing and then you might not feel like … you are just kind of left dangling out there and whatever last message they had is the last one you are going to hear for them. … To be able to end it with a face-to-face might actually make the participants have a better view of the program.

Other suggestions for increasing interaction were more task-oriented. One mentor suggested that each student-mentor pair be given a small research project they could work on together.

> Grimsby: Maybe somehow having something that they needed to accomplish during the quarter … with their mentor. I mean, a small project, maybe some research thing that … it would be difficult for them to do without some outside assistance, to drive them to, you know, a communication on that. Because once you get involved in the conversation … even if it's not science related, then other things start to happen.

Students also suggested that specific interactions be assigned to them, and one of the mentors suggested that interaction be more connected to what was being discussed in class:

> Vincent: Perhaps if you had it tied in a little closer with the class, like actually have the professor do some sort of informal assignment where... Talk to your mentor about this, or Get your mentor's opinion on this topic or that topic.

In spite of their knowledge that the program was designed to test the effectiveness of mentoring programs where face-to-face contact was not possible, several participants (two Urban University students and four Company 2 mentors) suggested that there be at least one face-to-face meeting or phone conversation between mentor and student, possibly at the beginning.

> Quest: You need to break that, I guess, barrier of impersonality. If you manage to have a phone conversation first time around, introduce yourself, blah, blah, blah … then to me it's much easier then to write to somebody.

> Henshaw: I think a face-to-face actual, you know, contact meeting, "Hello, how are you doing," you know, shake of the hand and everything, I think … the people who didn't have a good connection with their mentor might have had a feel right then "OK, this is not going to work," because, you know, your first impressions are the lasting impressions. So sometimes you know "OK, I think I need to switch mentors."

One mentor suggested that a formative evaluation of the program and the individual relationships be conducted at the midpoint.

> Babcock: So that if you become frustrated early in the program, it doesn't last until the end of the program, so that something can be done to, you know, correct it or change it, so you can benefit from it.

Some participants (three Company 1 and three Company 2 mentors) asked for email notification that would signal participants that they had new messages to read or that would let participants know about unread material on the home page. (It should be noted that email notification of all relevant postings was sent to the participants in Spring 2000, Urban University and Company 2.)

Several mentors appreciated the guidance and support offered by the facilitators:

> Yu: I was glad that you guys did say right at the start that… to expect students to be quite reticent and that they, it would take them a lot longer to open up and come forward because that was clearly my experience. And I think had I not known that, then I … would've been quite concerned.

> Thompson: I know that there were weeks that went by that I didn't log on … but [the student] also was slow at times. … And I [don't remember which facilitator it was] who said, "And you guys are doing better that the other group did." So it made me think that, "Well, things are going okay."

One graduate student commented that the program seemed more suited to undergraduates:

> Invergordon: I think undergraduates would be more apt to participate. As an undergrad, many of them really don't know what they want to do. They know they're interested in biology, and so the mentor may help to, to shape their path. And so I think, I think as a grad student, it's too late for the most part. You're already doing what you want to do.

Unlike some of her peers, this student saw the mentor's role as focusing on selection of a career, rather than advancement of a career on which she had already embarked. The program might have been more useful if more care had been take to shape the students' expectations.

Other individual suggestions from the students included: offer links to scientific sites from the program site; make the kickoff a contest; add more real-time chat; have questions to fax to mentors; more variation in terms of participants; more open-group discussions; include a log-off button; include a news forum; automatically update the discussion forum; and tie the program to another course. Individual recommendations from the mentors included: monitor the kickoff for mentoring vs. tutoring; screen students; include non-Ph.D. mentors; tell students that the mentors are there to help; involve multiple companies; include only seniors; have more course content up front; bring instructor in as mediator; remove mentors-only forum; gear program toward helping students with thesis topics; give student access to cheap email devices; suggest that mentors put the need to email students on their calendars; provide hands-on training for mentors before kickoff so that they could concentrate on the students only at the kickoff event; emphasize the importance of the kickoff; match students with mentors based on the Myers-Briggs assessment; allow group chat; connect to other people and programs at the companies involved; provide the student photo and information before the kickoff event; make it clearer to mentors that they can come to the facilitators if a student isn't responding; encourage more group interaction; tell future mentors about past mentors' experiences to prepare them; and give more positive encouragement to students and mentors.

IV. DISCUSSION

There are many dimensions to the evaluation of the success of this (and similar) electronic mentoring projects. A rich view of the interactions that took place, and the participants' perspectives on those interactions, is available because data included capture of all the transaction logs of the Web-based discussion forums, pre- and post-semester questionnaires completed by the participants, and pre- and post-semester interviews conducted with the participants. The level and quality of interaction and the impact of the program on the student participants will be the focus of this discussion.

Amount of Mentor-Student Interactions

The overall quantity of interactions between mentors and students was reported in Tables 12 and 13. The two cohorts differed on their overall amount of communication, with more than twice as many messages posted during Spring 2000 as in Fall 1999. There are several possible sources of this difference. The Fall 1999 intervention was implemented in a rural university, where the students may have had less prior experience with the Internet than the students in Spring 2000. However, the students' self-reported computer skills did not differ, prior to beginning the program (see Table 29), so this explanation is not likely the cause of the difference in amount of postings. A second possibility is the influence of the course instructors. However, the Fall 1999 instructor was more actively engaged with the technology: the instructor posted 40 messages in Fall 1999, compared with 0 posted by the Spring 2000 instructor; and the Fall 1999 instructor used the Web site to organize chat sessions for exam reviews (not done in Spring 2000). The only evidence that would suggest that the Spring 2000 instructor had a more positive influence on students' postings was the comment of some students that the instructor strongly encourage them to correspond with their mentors. A third possible explanation of the overall difference in amount of student activity is the difference in the activity of the mentors, over time (see Figure 2). During the first month of the program, the students in each cohort posted almost the same number of messages per day (2.6 in Fall 1999 versus 2.9 in Spring 2000). However, in that same month, there was a large difference in the postings of their mentors (1.4 per day in Fall 1999 versus 4.0 per day in Spring 2000). In month 2, there are two sharp declines: in the number of postings by the students at Rural University (Fall 1999) and in the number of postings by the Company 2 (Spring 2000) mentors. Both groups are likely responding to the lesser activity of their partners during month 1. In month 2, the daily postings by the Urban University students (Spring 2000) sharply increased, most likely responding to the high level of first-month activity by their mentors. All groups were relatively stable in months 3 and 4. Based on these results, the overall difference in amount of student posting can be attributed to the activity levels of their mentors. It seems likely that participants interpreted their partner's level of activity as representing his or her level of commitment to the exchange, a key relationship factor affecting one's willingness to engage in a mentoring relationship (Young & Perrewé, 2000). For future electronic mentoring programs, the mentors should be encouraged to post messages frequently, and it is likely that this will encourage students to post frequently.

As expected, most of the messages posted by students went to their mentors. More specifically, 58% of the Fall 1999 student postings were to mentors (see Table 12) and 61% of the Spring 2000 student postings were addressed to mentors (see Table 13). Such behavior was encouraged by the facilitators and by the course instructors; this type of communication was seen as the major focus of the electronic mentoring program. Even with encouragement, however,

this level of activity cannot be taken for granted. During spring 1993, Harris and Jones (1999) found that only 17.5% of the messages posted in the electronic Emissary Project were sent from students to the subject matter experts working with them.

The students also communicated fairly frequently with each other: 17% of the Fall 1999 student postings were to other students, 25% of the Spring 2000 postings. For most of these students, this was their first exposure to Web-based discussion forums and their first use of the Web in support of a course. Clearly, they found it beneficial for their communications with peers. Their comments in the post-semester interviews also corroborate this conclusion, with several references to the advantages of being able to use the Web site to communicate with their peers.

One way in which the two cohorts differed in their communication patterns was the proportion of messages posted to the course instructor. In the Fall 1999 pilot study, 16% of the student postings went to the instructor, while only 4% of those in the Spring 2000 pilot study went to the instructor. It is likely that this difference can be attributed to the differences in the activity levels of the two instructors (40 postings versus 0 postings, as noted above), with the activity levels of the instructors serving as encouragement (or lack of it) for using the Web-based forums for student-teacher interactions. Based on student comments in the post-semester interviews, it is clear that the Spring 2000 instructor preferred face-to-face communication with the students and did communicate with them frequently in that way.

As discussed above, the number of messages posted by the mentors differed dramatically between the two cohorts (97 postings in Fall 1999, 274 in Spring 2000). However, they did not differ in the proportion posted to students. Both sets of mentors posted their messages predominantly to students: 82% in Fall 1999 and 87% in Spring 2000. Another way to examine this interaction is in the direction of the flow of messages. In Fall 1999, there were almost exactly the same number of messages posted from mentor to student as from student to mentor. In Spring 2000, more messages were sent mentor to student (n=239) than were sent student to mentor (n=182). From Figure 2, it can be seen that, in month 2, each group reacted to the other's level of activity during month 1, with the students increasing their activity and the mentors decreasing their activity. If we had been able to anticipate the student increase in activity and the mentors had been able to maintain their level of activity into the second month of the program, both groups might have been more satisfied with the overall outcomes.

One of the general questions that was not answerable at the beginning of the program concerned the level of activity that participants should be encouraged to maintain. Clearly, more activity would be better, but most participants were under some time constraints and were worried about the amount of time they might need to devote to the program. Therefore, the facilitators recommended that each participant try to post at least one message per week. During Fall 1999, there were 13 messages posted per pair (about 1 per week); during Spring 2000, there were 28 messages posted per pair (about 2 per week, or 1 per participant per week). Thus, the Spring 2000 program achieved about the level of activity that was originally recommended by the facilitators. Based on the post-semester comments from all the participants, it can now be concluded that this level of activity is the minimum required to consider the program a success.

Quality of Mentor-Student Interactions

One way that the quality of mentor-student interactions can be assessed is in their degree of interactivity. Taking an earlier definition from Bretz, Henri (1992) defines interactivity as a

three-step process involving communication of information, a reponse to this information, and a reply to that first response. The presence or absence of these three-part chains of communications is an indicator of the degree of interactivity within a particular Web-based forum. Based on this definition, the mentor-student forums in both semesters were reasonably interactive. The average length of a thread in Fall 1999 was 3.0 and in Spring 2000 was 3.6 (see Table 14). In both semesters, more replies were posted than were independent statements (see Tables 16-17). In Fall 1999, students posted 51 independent statements and 83 replies and mentors posted 29 independent statements and 68 replies; in Spring 2000, students posted 80 independent statements and 217 replies and mentors posted 94 independent statements and 180 replies. A closer look at the patterns of interactions that actually occurred in the mentor-student forums (as illustrated by examples in Figures 3-4) indicates that the Spring 2000 forums were more interactive: threads, when they occurred, tended to be longer and more complex than the typical threads in Fall 1999. It is likely that most of this difference can be attributed to the overall difference in level of activity across the two cohorts.

A second perspective on the mentor-student interactions is to examine who is initiating the discussions. A broad view of this aspect of the interactions can be obtained by looking at the ratio of responses to independent statements for each group in each cohort. In Fall 1999, the mentors posted 2.3 times as many responses as independent statements, while the students posted 1.6 times as many responses as independent statements. In Spring 2000, the mentors posted 1.9 times as many responses as independent statements and the students posted 2.7 times as many responses as independent statements. From these data, we can conclude that, in the Fall 1999 program, the students initiated more of the threads, with the mentors responding. This pattern was reversed in Spring 2000, with the mentors initiating more threads and the students responding. As the more senior member of the pair, it can be argued that the mentor should take responsibility for initiating threads of discussion.

A completely different measure of the quality of the student-mentor interactions can be obtained by examining their responses to questions about the quality of the match. All of the participants reported that the quality of their match was at least "neutral" on a 5-point scale ranging from "very poor" to "excellent". For both semesters, the students were very pleased with the match with their mentors, with approximately 75% describing the match as "good" or "excellent". The mentors were somewhat more guarded in their assessments, with only about 50% describing the match as "good" or "excellent". As discussed earlier, the matches were based primarily on the information provided as part of the participants' profiles: science topics they'd like to discuss, career topics they'd like to discuss, and their academic background. In addition, the matches were made through consultation among the facilitators (who had met all the mentors) and the instructors (who had met all the students). While personality characteristics were not explicitly taken into account in assigning mentors to students, possible personality clashes were avoided as much as possible. In a few cases, there was additional personal information that was taken into account, e.g., one student was interested in further study in Britain and was matched to one of the mentors working there. This match worked out very well for both participants, indicating that these types of individual differences can assist in making appropriate matches.

Participants were also asked several questions about the quality of their relationships on the post-semester questionnaire. Overall, participants had positive impressions of each other. Their responses to the questionnaire, on a 5-point scale, averaged 3.4 or above. The Fall 1999

students did have somewhat more positive impressions of their mentors than vice versa: they were more likely to believe that their mentors were interested in them than vice versa and they were more interested in face to face meetings. During the post-semester interviews, participants gave positive descriptions of their partners. However, there were many expressions of disappointment in the level of the relationship between mentor and student. In most cases, the relationship was described as professional and impersonal, and many of the participants had hoped that it would develop further into a more personal relationship as might be expected between a mentor and protégé.

In summary, the relationships between the mentors and students in these two pilot studies can be characterized as reasonably interactive (with some room for improvement). The matches of students with mentors were fairly successful (especially given the small pool of each). The relationships that formed between the mentor-student pairs were on a professional level, which was more satisfactory to some participants than to others.

Impact of the Program on Student Participants

The primary effects experienced by the student participants were a personal relationship with their mentors (both semesters), enhanced career choices (Fall 1999), increased interest in science (Fall 1999), and increased use of technology. The mentors believed that the effects most often experienced by the students were increased use of technology (Fall 1999) and enhanced career choices (Spring 2000). Some of the students' unfulfilled expectations included their hope for improved grades (Fall 1999),[3] enhanced career choice (Spring 2000) and increased science proficiency (Spring 2000). This discrepancy between expectations and perceived impact is not uncommon to electronic mentoring programs. In the large-scale electronic mentoring program established at Hewlett-Packard, it was concluded that, "Expectations of mentors and protégés alike far exceeded perceived impact" (Cobb, 1999, p.12). This program, which involved over 1,000 mentors of students in grades 5-12) has also reported their mentors' responses concerning their expectations of impact and their perceptions of actual impact (after having been involved in the program for over a semester). Prior to the program (September 1996), the mentors were very optimistic, the majority of the mentors expecting to have an impact in increasing student self-confidence, increasing student motivation in school, increasing student use of technology, enhancing career choices, increasing interest in math/science, increasing proficiency in math/science, improving grades, and increasing student involvement in school. In May 1997, these mentors were not as optimistic about their influence on their students. None of the possible impacts were expected by a majority of the mentors; only increased use of technology was expected by as many as 47% of the mentors (Cobb, 1999).

Additional items on the questionnaire were asked of the students both at the beginning of the program and after the program was concluded (see Tables 22-29). Very few changes were found between the responses on the pre-semester questionnaire and the responses on the post-semester questionnaire. There were no statistically-significant changes in academic attitudes. However, there were reports in the Fall 1999 post-semester interviews that the Web site provided strong support for the class and the students engaged in chat sessions in studying for their exams. In addition, the activity in the forums indicated that *all* of the Fall 1999 students participated in the students-only forum. There were no changes in the types or amount of computer use by the

[3] There was one noticeable exception to this conclusion. One of the Rural University students explicitly attributed her academic success in another course to the interactions with her mentor.

students (though they were not asked explicitly about their level of use of Web-based discussion forums). The students did increase their (self-reported) skills in the use of Web-based discussion forums, a finding parallel to the finding in the HP telementoring program (Cobb, 1999), that students increased their use of email, the platform for those students' interactions with their mentors. It can be concluded that the *E-Mentoring* program did have a positive influence on students' technology use, introducing them to a medium of communication to which they had not had previous exposure.

In interpreting these results, it's easy to be disappointed in them. It would be gratifying to find that the mentors had an immediate and major impact on the students' lives. However, it seems likely that many of the effects of the program will be experienced over a longr period of time; one often hears anecdotal evidence of mentoring program effects that are recognized many years after the program interactions were concluded. It is also difficult to assess the effectiveness of the *E-Mentoring* program as a whole, since comparative data for comparable face-to-face mentoring programs are not available.

Summary of Program Evaluation

It can be concluded that the participants were generally positive about their experiences with electronic mentoring. Many of them related incidents that provided evidence of positive relationships that formed between students and mentors. For a few of the students, the mentoring relationship provided significant positive benefits: they developed a relationship with their mentors that is likely to be long-term, or they got specific help with understanding science material or improving their grades. For most students and mentors, it was a pleasant experience, but there was no immediate important impact. It is possible that the impact of the relationship may be more fully experience upon later reflection. For a few students, the program was unsuccessful. They never developed a relationship with their mentors, and so did not receive any benefits from their participation (other than their introduction to a new technological communication tool). However, none of the relationships would be considered "dysfunctional" (Feldman, 1999).

At the beginning of the program, many of the participants commented that they were concerned that their participation would take too much time. This concern was especially common among the mentors, but was also expressed by some of the students. By the end of the program, this concern had evaporated, and many of the participants were longing for more interaction. In particular, the students at Rural University were disappointed in the level of interaction with their mentors, and the mentors at Company 2 were disappointed in the level of interaction with their students.

The time constraints experienced by the mentors were primarily a result of the social norms in place in each company. The differences in perspectives is hinted at in the data on the mentors' expectations for effects on their own lives. About half the mentors in Company 2 expected that their participation would "help [them] meet organizational goals by developing future employees and increasing diversity in the workforce." None of the mentors in Company 1 had this expectation. Company 2 had a long history of participation in mentoring programs of various types, from postdoctoral research fellows being appointed in their research labs, to company-supported volunteer tutoring of local elementary science students. In Company 2, there were also internal mentoring activities, oriented to the development of current staff. There was no such culture at Company 1. None of the mentors mentioned any current mentoring

efforts that were supported by the company. A few were occasionally involved with summer interns, but they saw these students as employees rather than protégés. In addition, the explicit corporate support for the *E-Mentoring* program differed between the two companies. In Company 2, there was full management support for participation and the mentors were recruited by their manager. In Company 1, there was initial corporate support by a manager, but he left the company prior to the implementation of the program and so was not there to champion his staff's participation. The manager had initially recruited the mentors, but comments in the pre-semester interviews indicated that their participation was not viewed, by them, as totally voluntary. In addition, Company 1 had experienced significant downsizing throughout the preceding 18 months. Without explicit management support, the mentors were concerned that time spent on communicating with the students would be viewed as time wasted. While Company 2 was about to be involved in a merger, the mentors did not feel personally at risk of losing their jobs, and were supported in their use of time at work for communicating with the students. The effects of these cultural differences can be seen in the higher level of activity in Company 2 and higher expectations for impact.

Though the mentoring program had limited impact on the students, they reported (on the post-semester questionnaire) that the use of the Web site was well-integrated into the course and influenced the course interactions. Both sets of students reported that, because of their interactions with technology in the course, it was more likely that they would communicate with people from around the world. Particularly at Rural University, this finding can be seen as a signal that Web-based communication can broaden students' horizons. Both cohorts of students reported that they put more thought into their comments to the class, because of the use of the technology. The freedom to compose and edit a message before posting it is often cited as a positive effect of asynchronous communication, and this benefit was clearly perceived by the participants in the *E-Mentoring* program. The graduate students at Urban University also reported additional technology-related effects. They said they were more likely to discuss course-related concepts with other students and that they received responses to their comments. The undergraduate students at Rural University reported that they were less likely to feel isolated from their peers and the instructor and that they were more likely to receive detailed instructor feedback quickly. All of these effects can be viewed as positive outcomes of the program, contributing to the academic experience of the student participants.

The students also responded to questions related to the challenge of using a new technology. The graduate students at Urban University reported that it was easy to learn the technology, and the undergraduate students at Rural University reported that they did not feel at a disadvantage because of their computer or typing skills. Thus, implementation of the technology did not seem to have any significant negative impact on those students who had less experience or skill in using computers or the Internet.

One of the implementation issues faced by the research team was the technology platform to be used for implementing an electronic mentoring program. There are some advantages to using email for the platform, and some advantages to using Web-based discussion forums. In general, email can be seen as a "push" technology. When someone sends a message, it comes directly to the desktop of the intended recipient. Web-based discussion forums might be seen as more of a "pull" technology, since the message recipient must go to a Web site to retrieve any messages that might have been posted to him or her. Given the goal of increasing the communication activity between participants, email has advantages over Web-based discussion

forums. Another difference is in the display of the messages sent. With email, messages all go to the inbox and are interleaved with any other messages arriving for the recipient, resulting in a lack of interactional coherence because turn adjacency is disrupted (Herring, 1999). With a Web-based discussion forum, this problem is overcome since messages are threaded, i.e., those associated with a particular subject are displayed together and not intermingled with messages on other topics. On this dimension, Web-based discussion forums had advantages for the type of mentoring-related communications envisioned for this program. A third difference between the two platforms is in the retention of older messages. With email, the recipient may leave the messages in the inbox indefinitely, may delete them at any time, or may store them in folders created for that purpose. With a Web-based discussion forum, the messages are retained indefinitely, ordered by the date a thread was begun (generally newest at the top). For the study participants, this effortless retention and organization of messages was advantageous. In addition, the archiving of messages made the use of transaction logs for research purposes very efficient and more thorough than would have been possible with an email-based system.

In participants' comments on the technology platform used for the *E-Mentoring* program, the issue of push versus pull was an important one. Without email notification of new messages received, the recipient was more likely to neglect going to the Web site to check on new postings. For the purposes of electronic mentoring, where the number of participants in each forum is very small, i.e., two, it is necessary to ensure that participants are notified quickly when a new posting is waiting for them.

V. RECOMMENDATIONS

Based on the findings of this study, additional electronic mentoring projects are encouraged. While direct and immediate effects of the program were significant for only a small proportion of the participants, they were possible. For almost all of the participants, it was a positive experience. In addition to the effects of mentoring for these students, they experienced some benefits through increased skill in use of Web-based discussion forums and through the integration of technology into their course work.

To successfully implement an electronic mentoring program, pairing corporate mentors with students, it is critical to have explicit organizational support. Ideally, someone in the corporation's management should be willing to serve as a champion for the program, helping to recruit and reward mentors. Communications within the corporation should make it clear that the participation by the individual mentors is valued by the corporation and helps it to obtain some of its goals. A variety of mechanisms can be used to ensure that the mentors understand the value of their work to the corporation, depending on what types of communication patterns routinely occur within the corporation. For example, in the companies participating in these studies, it was appropriate to place posters describing the program in the corporate headquarters lobby or lunchroom and for their managers to write memos thanking them for their participation. Other methods might be more appropriate in other organizational cultures.

In addition to organizational enthusiasm for the program, the enthusiastic participation of the individual mentors is also critical to the success of an electronic mentoring program. The mentors participating in the two pilot studies varied in their levels of enthusiasm. For example, one mentor essentially dropped out, not sending any messages to his student during most of the semester. A generally positive attitude toward participation is really not enough; the mentor must make mentoring a priority in order for communication with a student to become a regular practice.

One of the reasons that both organizational and individual commitment to participation is important is that the level of activity by the mentors can influence the level of activity by the students, thus affecting the success of the program as a whole. Our data indicated that participants responded to the activity level of their partners, increasing the frequency of their postings if their partner was very active and decreasing the frequency of their postings if their partner was less active. While the advice to post a message at least once each week seems to be reasonably valid, it is important to encourage mentors to be even more active in order to foster participation by their student protégés.

The likelihood of success of an electronic mentoring program can be increased by beginning with some type of kickoff event. In these two pilot studies, the initial event was based on interactions among all the participants via the same Web site (and some special forums established on it) as would be used throughout the semester. Some participants encouraged videoconferencing to augment the event, but the administrative overhead may not be worth the benefits received. The content of the kickoff event should allow participants to become acquainted, and should provide some "practice" in the same style of communication that would be appropriate throughout the program.

The Web-based discussion forums used in these pilot studies was a satisfactory technology platform. It suffered from the fact that email notification was necessary to alert

participants to relevant new postings. However, the availability of threaded discussions that were automatically retained and sorted was an advantage. In addition, the Web-based technology was easy to integrate with the use of the Web site for other course-related activities and services.

For the purposes of the research, participants in these two pilot studies were asked not to contact each other by means other than the Web-based discussion forums. In spite of this request, a few participants did contact each other by phone or email. Late in Spring 2000, a few of the Urban University students visited Company 2. During the post-semester interviews, a number of participants suggested that the Web-based discussion forums be augmented with other communication media such as telephone and videoconferencing. Such augmentation may be effective, if the budget of an electronic mentoring project has the means available.

In summary, electronic mentoring offers a unique opportunity for students who are isolated from possible role models to become acquainted with and be mentored by such role models. In the case of these pilot studies, the goal was to enrich the academic experience of biology students in historically-minority universities by providing them with mentors who were corporate scientists. While it may not have been as significant an experience as face-to-face mentoring by these same people, face-to-face mentoring is impossible. The benefits received through electronic mentoring were definitely worth the small costs of implementing such a program.

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VI. APPENDICES

A. Instruments for gathering student and mentor profiles
B. Pre-program questionnaire for students
C. Pre-program questionnaire for mentors
D. Courses already completed by participating students
E. Pre-program interview schedules for students and mentors
F. Mentor/student pairs (aliases)
G. Post-program questionnaire for students
H. Post-program questionnaire for mentors
I. Post-program interview schedules for students and mentors

Appendix A

Instruments for gathering student and mentor profiles

E-Mentoring
Electronic mentoring for tomorrow's scientists

Welcome to the E-Mentoring Project!

E-mentoring is the establishment and continuance of a mentoring relationship between students, teachers, and mentors using communications and information technology. This project is being administered by *[project team members.*

We are currently developing profiles of all participants. These profiles will help introduce students, mentors, and faculty to each other; as well as help us match you with appropriate students.

To submit your profile, please respond to the following questions and return the form as soon as possible to *[project team member.]*

*Please note that the information you provide for items that are ***italicized*** will be made available to all participants. Those items **not in italics** will be only available to the administers of the e-mentoring project for matching purposes.

Name:

E-mail address:

Field of Study (College Major):

Science topics I am most interested in discussing with students:
(Please check as many topics as you wish)

□ General Biology
□ Biochemisty
□ Bioinformatics
□ Biostatistics
□ Bio-medical Engineering
□ Cell Biology
□ Chemistry
□ Ecology
□ Genetics
□ Marine Science
□ Pharamcology
□ R&D in the Pharma-environment
□ Computer Science
□ International Research Initiatives
□ Medicine
□ Molecular Biology/Biotechnology
□ Science & society
□ Science & government policy
□ Other _____

Career topics I am most interested in discussing with students:
(Please check as many topics as you wish)

□ Medical school
□ Getting a job/internship
□ Benefits of getting a Ph.D.
□ Career options with a master's
□ Balancing career and family
□ Professional organizations
□ Publishing
□ Attending conferences
□ Teaching
□ Diagnostics or Forensics Lab
□ Genetic counseling
□ Research in academia
□ Research in corporations
□ Research in government labs
□ Science patents and inventions
□ Other: _____

Why I'm interested in biology:

Career history and goals:

Free time interests; part-time job; family; unique qualities about me; interesting facts about me; etc...

Mentor Profile Example:
"My name is Chris Mentor and I'm a researcher at Ortho-Clinical Diagnostics which is a division of Johnson and Johnson. I received my Bachelor's degree in biochemistry from University of Michigan in 1983. I first got interested in biology during my sophomore year in high school—dissecting the frogs was fun. I enjoyed learning how living things live and breathe.

After college, I worked in a cancer research lab in Boston. I thought I would go to medical school after a few years in the lab, but I realized I enjoyed research so much I'd continue in this line of work. In 1990 I moved to NJ and was lucky enough to land a satisfying research job at Ortho-Clinical. I enjoy the fact that my daily work positively contributes to the field of biochemistry.

To keep abreast of advances in the field, I read science journals and try to attend conferences that are applicable to my work.

I currently live in Hoboken, New Jersey with my wife who is a grade school teacher and three sons. I enjoy fishing on the weekends and tooling around in my garden."

Thank you for your time and attention! We look forward to working together with you.

E-Mentoring
Electronic mentoring for tomorrow's scientists

Welcome to the E-Mentoring Project!

E-mentoring is the establishment and continuance of a mentoring relationship between students, teachers, and mentors using communications and information technology. This project is being administered by *[project team members.]*

As part of the *[name of course]* course that you have enrolled in for this semester, you will be interacting with a scientist in the field as part of the E-mentoring project.

We are currently developing profiles of all those participating. These profiles will help introduce students, mentors, and faculty to each other; as well as help us match you with an appropriate mentor.

To submit your profile, please complete the following form and return it by *[date]* to *[project team member.]*

*Please note that the information you provide for items that are ***italicized*** will be made available to all participants. Those items **not in italics** will be only available to the administers of the e-mentoring project for matching purposes.

Name: _____

E-mail address (if available): _____

Major(s) & Minor(s): _____

Science topics I am most interested in discussing with a mentor (check as many as you wish):

□ General Biology
□ Biochemisty
□ Bioinformatics
□ Biostatistics
□ Bio-medical Engineering
□ Cell Biology
□ Chemistry
□ Ecology
□ Genetics
□ Marine Science
□ Pharamcology
□ R&D in the Pharma-environment
□ Other _____
□ Computer Science
□ International Research Initiatives
□ Medicine
□ Molecular Biology/Biotechnology
□ Science & society
□ Science & government policy

Career topics I am most interested in discussing with a mentor (check as many as you wish):

□ Medical school
□ Getting a job/internship
□ Benefits of getting a Ph.D.
□ Career options with a master's
□ Balancing career and family
□ Professional organizations
□ Publishing
□ Attending conferences
□ Teaching
□ Diagnostics or Forensics Lab
□ Other: _____
□ Genetic counseling
□ Research in academia
□ Research in corporations
□ Research in government labs
□ Science patents and inventions

Please continue on next page….

Why I'm interested in biology:

What classes I take; what classes I really enjoy:

Career plans:

Free time interests; part-time job; family; unique quality about me; interesting facts about me; etc...

Student Profile Example:
"My name is Pat Student and I'm a junior Biology major at ECSU. I first got interested in biology when I was a kid playing at the beach. I used to enjoy examining fish and other sea creatures that washed up on the beach. It seems gross now, but my parents introduced me to the wonders of living things.

In addition to my basic biology requirements, I have also taken some advanced chemistry and a genetics course. I also take a Spanish class each semester.

Although I don't know much about how to become a bio-medical engineer, I think that's what I might like to do for a living.

I've lived in North Carolina my whole life. I have one brother, who also attends ECSU part-time. I enjoy fishing, running and reading John Grisham novels. I also love cats and can't wait to have one of my own once I graduate."

Thank you for your time and attention! We look forward to working together with you.

Appendix B

Pre-program questionnaire for students

PRE-SEMESTER SURVEY: STUDENTS

We appreciate you taking the time to complete the following questions. Your answers are important because they may shape the future of the E-Mentoring program by enabling us to build the best E-Mentoring system possible. Thank you very much.

Name _____

Academic Profile

1. Prior to this semester, how many credits have you completed toward your undergraduate degree?
   _____ credits

2. Are you a full-time student or a part-time student?
   ❍ Full-time student ❍ Part-time student

3. Please list the biology courses that you've already taken at Elizabeth City State University.

   _____ _____

   _____ _____

   _____ _____

4. Why did you decide to take this course (Frontiers in Molecular Biology)? (Check all that apply.)

   ❒ to fulfill a general education requirement
   ❒ to fulfill a requirement for my major
   ❒ the subject matter looked interesting
   ❒ the instructor has a good reputation
   ❒ it was offered at a convenient time
   ❒ it was offered at a convenient location
   ❒ it was offered via _____ technology
   ❒ other (please specify) _____

5. Do you plan to earn a degree from this university?
   ❍ Yes ❍ No

6. What is the highest degree you plan to earn from any college or university?

   ❍ Certificate
   ❍ A.A. or A.A. S.
   ❍ B.A. / B.S.
   ❍ M.A. / M.S.
   ❍ Ph.D. / Ed.D.
   ❍ J.D.
   ❍ M.D.
   ❍ other (please specify _____)
   ❍ I don't expect to earn a degree.

7. Which of the following best describe(s) your reason for taking college courses at this time? (Check all that apply.)

❒ to advance in current job or career
❒ to discover new job opportunities
❒ personal enrichment
❒ to earn a college degree
❒ other (please specify: _____)

8. Doing well in school is _____ to me.

❍ important
❍ somewhat important
❍ somewhat unimportant
❍ unimportant

9. I feel I have _____amount of responsibility for my own learning at school.

❍ a great
❍ some
❍ little
❍ no

10. I feel _____in my classwork at school.

❍ very involved
❍ somewhat involved
❍ somewhat uninvolved
❍ uninvolved

11. I feel I have the ability to pursue a career in science.

❍ strongly agree
❍ agree
❍ am unsure
❍ disagree
❍ strongly disagree

12. At the end of last term, what was your grade point average at <u>this institution</u>?

❍ A+ or A
❍ A- or B+
❍ B or B-
❍ C
❍ D or F

13. Do you live on campus or off campus?

❍ On campus ❍ Off campus

14. <u>If you live off campus</u>, on average how many hours per week do you spend on campus excluding time spent in classes or working for pay?

_____ hours per week

Expectations of the E-Mentoring Program

15. How do you expect to be affected by your mentor or your participation in the E-mentoring program? (Select from the items below the top three items that you believe represent the greatest impact areas.)

    - ❒ Increase interest in science
    - ❒ Increase science proficiency
    - ❒ Improve grades
    - ❒ Enhance career choices
    - ❒ Increase motivation to succeed at school
    - ❒ Increase self-confidence
    - ❒ Increase involvement at school
    - ❒ Increase use of technology
    - ❒ Develop friendship, personal relationship with mentor
    - ❒ Other _____

Technology/Information Use

Rate your ability to do each of the following:
(Circle the appropriate number, from 1, no knowledge/ability, to 5, expert user.)

	No knowledge/ ability	Some knowledge, but little ability	Novice user	Inter-mediate user	Expert user
16. Create a word processed document on a computer	1	2	3	4	5
17. Send and receive e-mail	1	2	3	4	5
18. Search for information on the Internet/World Wide Web	1	2	3	4	5
19. Participate in online chat sessions	1	2	3	4	5
20. Participate in threaded e-mail discussions (i.e., use electronic bulletin boards)	1	2	3	4	5
21. Create or edit a World Wide Web site (using such programs as html, java, etc.)	1	2	3	4	5
22. Electronically send and receive files by way of the computer (over a modem, the Internet/WWW etc.)	1	2	3	4	5
23. Program a computer using a programming language (such as Fortran, C, C++, or a database language such as Foxpro or Oracle, etc.)	1	2	3	4	5

24. What type of computer do you use? (Check all that apply.)

	Macintosh/ Apple	DOS/ Windows	Windows/ NT	Unix	Other (please specify)*	Not applicable
At home?	❒	❒	❒	❒	❒	❒
At work?	❒	❒	❒	❒	❒	❒
In college/university computer lab (either on campus or at a remote/ community site)	❒	❒	❒	❒	❒	❒

*Specify other type of computer: Work: _____

Home: _____

College/university lab: _____

25. Which Internet/World Wide Web browser do you use? (Check all that apply.)

❒ Netscape
❒ Microsoft Internet Explorer
❒ Mosaic
❒ None/Not Applicable
❒ Don't Know
❒ Other (please specify:_____)

26. How satisfied are you with the speed with which your computer system connects to the Internet or World Wide Web...

	Very Dissatisfied	Dissatisfied	Satisfied	Very Satisfied	No Basis for Judgment/ Not Applicable
From home?	1	2	3	4	❍
From work?	1	2	3	4	❍
From [this university]?	1	2	3	4	❍

27. <u>At school and/or work</u>, I use computers mostly... (Select from the items below the <u>top two items</u> that you believe represent most of your computer use.)

❒ to play games
❒ for word processing
❒ for class projects
❒ to use e-mail
❒ to access the Internet
❒ to do graphic design
❒ to design Web pages
❒ to do programming
❒ other _____

28. At home, I use computers mostly... (Select from the items below the top two items that you believe represent most of your computer use.)

- ❒ to play games
- ❒ for word processing
- ❒ for class projects
- ❒ to use e-mail
- ❒ to access the Internet
- ❒ to do graphic design
- ❒ to design Web pages
- ❒ to do programming
- ❒ other _____

29. How many hours per week do you use your computer for personal, study, or work-related reasons?

- ❍ Less than 1 hour
- ❍ 1 to 5 hours
- ❍ 5 to 10 hours
- ❍ 11 to 20 hours
- ❍ 21 to 40 hours
- ❍ over 40 hours/week

30. How many of the following information resources have you used during the past two months? (Check all that apply.)

- ❒ Browsed materials in corporate/university library
- ❒ Studied materials in corporate/university library
- ❒ Borrowed materials from corporate/university library
- ❒ Photocopied materials from corporate/university library
- ❒ Searched online library catalog
- ❒ Searched for scholarly/professional materials in printed abstract & index services
- ❒ Searched for scholarly/professional materials via CD-ROM databases
- ❒ Searched for scholarly/professional materials from the World Wide Web
- ❒ Received preprints or drafts of papers from colleagues/professors
- ❒ Shared scholarly/professional interests with colleagues/peers in face-to-face communication
- ❒ Shared scholarly/professional interests with colleagues/peers in electronic communication

Demographic Profile

31. Age: _____

32. Sex: ❍ Male ❍ Female

33. Race/Ethnicity: (Check all that apply.)

- ❒ American Indian/Alaskan Native
- ❒ African-American/Black
- ❒ Asian/Pacific Islander
- ❒ White
- ❒ Hispanic/Latino
- ❒ Other: _____

Thank you for completing this survey.

Appendix C

Pre-program questionnaire for mentors

PRE-SEMESTER SURVEY: MENTORS

We appreciate you taking the time to complete the following questions. Your answers are important because they may shape the future of the E-Mentoring program by enabling us to build the best E-Mentoring system possible. Thank you very much.

Expectations for the E-Mentoring Program

1. How do you expect to affect the student(s) you are mentoring? (Select from the items below the top three items that you believe represent the greatest impact areas.)

   - ❒ Increase interest in science
   - ❒ Increase science proficiency
   - ❒ Improve grades
   - ❒ Enhance career choices
   - ❒ Increase motivation to succeed at school
   - ❒ Increase self-confidence
   - ❒ Increase involvement at school
   - ❒ Increase use of technology
   - ❒ Develop friendship, personal relationship between mentor and student
   - ❒ Other _____

2. How do you expect to be affected by the E-Mentoring program and your students? (Select from the items below the top three items that you believe represent the greatest impact areas.)

   - ❒ Help meet organizational goals by developing future employees and increasing diversity in the workforce
   - ❒ Develop my professional network by making new contacts
   - ❒ Gain personal satisfaction from helping others
   - ❒ Gain more experience in mentoring
   - ❒ Increase my own use of technology
   - ❒ Learn (or re-learn) about biology topics that I wouldn't otherwise take the time or opportunity to explore
   - ❒ Learn about contemporary science education at the university level
   - ❒ Meet people who are different from myself (in age, race and ethnicity, cultural background, etc.)
   - ❒ Develop friendships, personal relationships with students
   - ❒ Other _____

Technology/Information Use

Rate your ability to do each of the following:
(Circle the appropriate number, from 1, no knowledge/ability, to 5, expert user.)

		No knowledge/ ability	Some knowledge, but little ability	Novice user	Inter-mediate user	Expert user
3.	Create a word processed document on a computer	1	2	3	4	5
4.	Send and receive e-mail	1	2	3	4	5

		No knowledge/ ability	Some knowledge, but little ability	Novice user	Inter-mediate user	Expert user
5.	Search for information on the Internet/World Wide Web	1	2	3	4	5
6.	Participate in online chat sessions	1	2	3	4	5
7.	Participate in threaded e-mail discussions (i.e., use electronic bulletin boards)	1	2	3	4	5
8.	Create or edit a World Wide Web site (using such programs as html, java, etc.)	1	2	3	4	5
9.	Electronically send and receive files by way of the computer (over a modem, the Internet/WWW, etc.)	1	2	3	4	5
10.	Program a computer using a programming language (such as Fortran, C, C++, or a database language such as Foxpro or Oracle, etc.)	1	2	3	4	5

25. What type of computer do you use? (Check all that apply.)

	Macintosh/ Apple	DOS/ Windows	Windows/ NT	Unix	Other (please specify)*	Not applicable
At home?	❒	❒	❒	❒	❒	❒
At work?	❒	❒	❒	❒	❒	❒
In college/university computer lab (either on campus or at a remote/ community site)	❒	❒	❒	❒	❒	❒

*Specify other type of computer: Work: _____

Home: _____

29. Which Internet/World Wide Web browser do you use? (Check all that apply.)

❒ Netscape
❒ Microsoft Internet Explorer
❒ Mosaic
❒ None/Not Applicable
❒ Don't Know
❒ Other (please specify:_____)

30. How satisfied are you with the speed with which your computer system connects to the Internet or World Wide Web...

	Very Dissatisfied	Dissatisfied	Satisfied	Very Satisfied	No Basis for Judgment/ Not Applicable
From work?	1	2	3	4	❍
From home?	1	2	3	4	❍

31. At work, I use computers mostly... (Select from the items below the top two items that you believe represent most of your computer use.)
    - ❒ to play games
    - ❒ for word processing
    - ❒ for class projects
    - ❒ to use e-mail
    - ❒ to access the Internet
    - ❒ to do graphic design
    - ❒ to design Web pages
    - ❒ to do programming
    - ❒ other _____

32. At home, I use computers mostly... (Select from the items below the top two items that you believe represent most of your computer use.)
    - ❒ to play games
    - ❒ for word processing
    - ❒ for class projects
    - ❒ to use e-mail
    - ❒ to access the Internet
    - ❒ to do graphic design
    - ❒ to design Web pages
    - ❒ to do programming
    - ❒ other _____

16. How many hours per week do you use your computer for personal, study, or work-related reasons?
    - ❍ Less than 1 hour
    - ❍ 1 to 5 hours
    - ❍ 5 to 10 hours
    - ❍ 11 to 20 hours
    - ❍ 21 to 40 hours
    - ❍ over 40 hours/week

17. How many of the following information resources have you used during the past two months? (Check all that apply.)

    - ❒ Browsed materials in corporate/university library
    - ❒ Studied materials in corporate/university library
    - ❒ Borrowed materials from corporate/university library
    - ❒ Photocopied materials from corporate/university library
    - ❒ Searched online library catalog
    - ❒ Searched for scholarly/professional materials in printed abstract & index services
    - ❒ Searched for scholarly/professional materials via CD-ROM databases
    - ❒ Searched for scholarly/professional materials from the World Wide Web
    - ❒ Received preprints or drafts of papers from colleagues/professors
    - ❒ Shared scholarly/professional interests with colleagues/peers in face-to-face communication
    - ❒ Shared scholarly/professional interests with colleagues/peers in electronic communication

Demographic Profile

18. Age: _____

19. Sex: ❍ Male ❍ Female

20. Race/Ethnicity: (Check all that apply.)

- ❒ American Indian/Alaskan Native
- ❒ African-American/Black
- ❒ Asian/Pacific Islander
- ❒ White
- ❒ Hispanic/Latino
- ❒ Other: _____

Thank you for completing this survey.

Appendix D
Courses Already Completed by Participating Students

Table D-1. Rural University

	Number of students who have completed the course
Comparative vertebrate anatomy	9
Cell biology	8
Principles of bioscience	6
Immunology	6
Zoology	6
Microbiology	5
Genetics	5
Physiology	5
Developmental biology	4
Botany	3
Organic evolution	3
Biological research	2
Histology	2
Intro. to experimental methods	2
Ethics in biotechnology	1

Table D-2. Urban University

	Number of students who have completed the course
Seminar	8
Bacteriology	7
Cell physiology	7
Biostatistics	6
Immunology	4
Histology	3
Introduction to research	2
Genetics	2
Techniques in molecular biology/biochem	2
Vertebrate histology	1
Morphology of invertebrates	1
Biochemistry	1

Appendix E

Pre-program interview schedules for students and mentors

Pre-program Interview questions for students

Introduction

- *Thank you for participating.*
- *It's from talking with you and getting your responses on surveys that we learn about electronic mentoring. You're the expert, and we hope to learn from your experiences and perceptions.*
- *[Explain and talk about study consent form. Ask for signature; offer signed copy.]*
- *I'd like to begin talking about finding and using information in general, and then about mentoring and electronic mentoring in particular.*
- *Do you have any questions at this point? Feel free to ask questions as we go along.*

1. You may have heard about the E-Mentoring program that will be part of the Frontiers in Biology course. [describe the program as needed.] What are your expectations of the program? What impact do you expect that your mentor will have on you?

2. What academic and personal areas or topics would you like to discuss with your mentor?

3. What characteristics do you expect your mentor to have?

4. What sort of relationship do you anticipate having with your mentor?

5. What impact do you expect to have on your mentor?

6. Do you have any concerns as you begin the E-Mentoring program? Are there specific things that you expect to find challenging?

7. What have been your previous experiences with respect to mentoring? E.g., have you participated in a formal (or informal) mentoring program before? Either as a mentor or protégé?

8. [Ask participant to talk about these experiences, e.g., were they satisfying/dissatisfying, and why?]

9. Is there anything you'd like to ask me?

Thank you very much! I appreciate your time and your willingness to discuss these things with us. It will help us design and plan future e-mentoring programs as well as better understand what impacts these types of programs have or don't have.

Pre-program Interview questions for mentors

Introduction

- *Thank you for participating.*
- *It's from talking with you and getting your responses on surveys that we learn about electronic mentoring. You're the expert, and we hope to learn from your experiences and perceptions.*
- *[Explain and talk about study consent form. Ask for signature; offer signed copy.]*
- *I'd like to begin talking about finding and using information in general, and then about mentoring and electronic mentoring in particular.*
- *Do you have any questions at this point? Feel free to ask questions as we go along.*

1. Why are you volunteering to participate in the E-Mentoring program?
2. What characteristics do you expect your students to have?
3. What impact would you *like* to have on your student(s)? What impact do you *expect* to have on your student(s)?
4. Do you expect your student to have an impact on you? How?/Why?
5. Do you have any concerns about the E-Mentoring program? What are they?
6. Are there specific things that you expect to find challenging?
7. What have been your personal experiences with respect to mentoring? For example, have you participated in a formal (or informal) mentoring program before? Either as a mentor or protégé?
8. Ask participant to talk about these experiences, e.g., were they satisfying/dissatisfying, and why?
9. Is there anything you'd like to ask me?

Thank you very much! I appreciate your time and your willingness to discuss these things with us. It will help us design and plan future E-Mentoring programs as well as better understand what impacts these types of programs have or don't have.

Appendix F
Mentor/student pairs (aliases)

Company 1 mentors	**Rural University students**
Gene Rarek	Joshua Ingram
Elise Mason	Adina Liggett (dropped), Denise Bushnell
Hank Markle	Deon Keyes
Scott Franklin	Jackie Elkan
Jane Chen	Yvonne Early
Ron Jobe	Aimee Richardson, Donna Kendrick
Linwood Jackson	Melissa Eckard
Dave Logan	Dawn Kearns
Chris Grimsby	Keita Moore, Desmina Hargrove
Company 2 mentors	**Urban University students**
Maggie Mulrony	Sharmaine Davis (dropped)
McKayla Nordby	Sara Babcock
Megan O'Leary	Sally Goodman
Milly Pavlova	Sandra Forester
Martin Quest	Simon Lewis, Sam Edwards (dropped)
Myron Ross	Sylvia Invergordon
Mindy Stone	Selia Henshaw
Moira Thompson	Simon Lewis
Monica Unger	Sonya Kellerman
Muriel Vincent	Steve Albertson
Marnie Waldheim	Susie Conner (deported), Sally Goodman
Meredith Yu	Sienna Johnson

Appendix G

Post-program questionnaire for students

Name _____

POST-SEMESTER SURVEY: STUDENTS

We appreciate you taking the time to complete the following questions. Your answers are important because they can shape the future of the E-Mentoring program by enabling us to build the best E-Mentoring system possible. Thank you very much.

Academic Profile/Expectations

1. Doing well in school is _____ to me.

   - ❍ important
   - ❍ somewhat important
   - ❍ somewhat unimportant
   - ❍ unimportant

2. I feel I have _____amount of responsibility for my own learning at school.

   - ❍ a great
   - ❍ some
   - ❍ little
   - ❍ no

3. I feel _____in my classwork at school.

   - ❍ very involved
   - ❍ somewhat involved
   - ❍ somewhat uninvolved
   - ❍ uninvolved

4. I feel I have the ability to pursue a career in science.

   - ❍ strongly agree
   - ❍ agree
   - ❍ am unsure
   - ❍ disagree
   - ❍ strongly disagree

Effects of the E-Mentoring Program

5. How were you affected by your mentor or your participation in the E-mentoring program? (Select from the items below the top three items that you believe represent the greatest impact areas.)

   - ❒ Increased interest in science
   - ❒ Increased science proficiency
   - ❒ Improved grades
   - ❒ Enhanced career choices
   - ❒ Increased motivation to succeed at school
   - ❒ Increased self-confidence
   - ❒ Increased involvement at school
   - ❒ Increased use of technology
   - ❒ Developed friendship, personal relationship with mentor
   - ❒ Other _____

Rate your level of agreement with each of the following statements:
(Circle the appropriate number, from 1, strongly disagree, to 5, strongly agree.)

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
6. My mentor was interested in me.	1	2	3	4	5
7. I was comfortable asking my mentor questions.	1	2	3	4	5
8. I am interested in continuing my relationship with my mentor.	1	2	3	4	5
9. I am interested in meeting my mentor face to face.	1	2	3	4	5

10. The overall quality of the mentor-student match was _____.

- ❍ very poor
- ❍ poor
- ❍ neutral
- ❍ good
- ❍ excellent

Technology/Information Use

Rate your ability to do each of the following:
(Circle the appropriate number, from 1, no knowledge/ability, to 5, expert user.)

	No knowledge/ ability	Some knowledge, but little ability	Novice user	Inter-mediate user	Expert user
11. Create a word processed document on a computer	1	2	3	4	5
12. Send and receive e-mail	1	2	3	4	5
13. Search for information on the Internet/World Wide Web	1	2	3	4	5
14. Participate in online chat sessions	1	2	3	4	5
15. Participate in threaded e-mail discussions (i.e., use electronic bulletin boards)	1	2	3	4	5
16. Create or edit a World Wide Web site (using such programs as html, java, etc.)	1	2	3	4	5

	No knowledge/ ability	Some knowledge, but little ability	Novice user	Inter-mediate user	Expert user
17. Electronically send and receive files by way of the computer (over a modem, the Internet/WWW etc.)	1	2	3	4	5
18. Program a computer using a programming language (such as Fortran, C, C++, or a database language such as Foxpro or Oracle, etc.)	1	2	3	4	5

19. At school and/or work, I use computers mostly... (Select from the items below the top two items that you believe represent most of your computer use.)

- ❒ to play games
- ❒ for word processing
- ❒ for class projects
- ❒ to use e-mail
- ❒ to access the Internet
- ❒ to do graphic design
- ❒ to design Web pages
- ❒ to do programming
- ❒ other _____

20. At home, I use computers mostly... (Select from the items below the top two items that you believe represent most of your computer use.)

- ❒ to play games
- ❒ for word processing
- ❒ for class projects
- ❒ to use e-mail
- ❒ to access the Internet
- ❒ to do graphic design
- ❒ to design Web pages
- ❒ to do programming
- ❒ other _____

21. How many hours per week do you use your computer for personal, study, or work-related reasons?

- ❍ Less than 1 hour
- ❍ 1 to 5 hours
- ❍ 5 to 10 hours
- ❍ 11 to 20 hours
- ❍ 21 to 40 hours
- ❍ over 40 hours/week

22. How many of the following information resources have you used during the past two months? (Check all that apply.)

- ❒ Browsed materials in corporate/university library
- ❒ Studied materials in corporate/university library
- ❒ Borrowed materials from corporate/university library
- ❒ Photocopied materials from corporate/university library
- ❒ Searched online library catalog
- ❒ Searched for scholarly/professional materials in printed abstract & index services
- ❒ Searched for scholarly/professional materials via CD-ROM databases
- ❒ Searched for scholarly/professional materials from the World Wide Web
- ❒ Received preprints or drafts of papers from colleagues/professors
- ❒ Shared scholarly/professional interests with colleagues/peers in face-to-face communication
- ❒ Shared scholarly/professional interests with colleagues/peers in electronic communication

Integration of Technology into Coursework

Think about a similar course you have taken that relied primarily on face-to-face discussions. Compared to that course, because of the way this course incorporated the E-Mentoring program, how likely were you to: (Check the appropriate circle, from much more likely to much less likely to no basis for judgment.)

	Much more likely	Somewh at more likely	About the same	Somewh at less likely	Much less likely	No basis for judgment/ Not applicable
23. ...actively participate in scheduled discussions about the course material (such as an in-class discussion section or a computer forum).	1	2	3	4	5	❍
24. ...ask for clarification when you didn't understand something.	1	2	3	4	5	❍
25. ...communicate with people from around the world.	1	2	3	4	5	❍
26. ...discuss the ideas and concepts taught in this course with other students.	1	2	3	4	5	❍
27. ...work on assignments with other students.	1	2	3	4	5	❍
28. ...ask other students for comments on your course work.	1	2	3	4	5	❍
29. ...feel isolated from other students.	1	2	3	4	5	❍
30. ...obtain help understanding course material from students/peers who do not attend this university.	1	2	3	4	5	❍

	Much more likely	Somewh at more likely	About the same	Somewh at less likely	Much less likely	No basis for judgment/ Not applicable
31. ...miss comments made during a discussion about the ideas and concepts taught in this course.	1	2	3	4	5	❍
32. ...received detailed comments on assignments from the instructor.	1	2	3	4	5	❍
33. ...receive comments from the instructor on assignments quickly.	1	2	3	4	5	❍
34. ...tell the instructor when you have a complaint or suggestion about the course.	1	2	3	4	5	❍
35. ...discuss your academic goals and/or career plans with the instructor.	1	2	3	4	5	❍
36. ...feel isolated from the instructor.	1	2	3	4	5	❍
37. ...discuss the ideas and concepts taught in this course with the instructor.	1	2	3	4	5	❍
38. ...get to know people who are different from you in their cultural and socioeconomic background.	1	2	3	4	5	❍

Indicate how strongly you agree or disagree with each of the following statements:
(Circle the appropriate number, from 1, strongly agree, to 4, strongly disagree or select no basis for judgment.)
Because of the way this course uses electronic communication:

	Strongly agree	Agree	Disagree	Strongly disagree	No basis for judgment/ Not applicable
39. ...I put more thought into my comments.	1	2	3	4	❍
40. ...I feel more comfortable asking an awkward question.	1	2	3	4	❍
41. ...it is difficult to relate to the other students in this class.	1	2	3	4	❍
42. ...it is easier to work with someone from a racial or cultural background different from my own.	1	2	3	4	❍
43. ...I waste too much time sorting through my messages to find the few that are useful.	1	2	3	4	❍

Because of the way this course uses electronic communication:

	Strongly agree	Agree	Disagree	Strongly disagree	No basis for judgment/ Not applicable
44. ...I waste too much time communicating with others on topics that are not directly related to my course work.	1	2	3	4	❍
45. ...I usually must wait a long time to use a computer.	1	2	3	4	❍
46. ...I spent too much time learning how to use the E-Mentoring Web site.	1	2	3	4	❍
47. ...I am better able to juggle my course work with my work and/or home responsibilities.	1	2	3	4	❍
48. ...I put in less time traveling to and from the campus.	1	2	3	4	❍
49. ...I don't receive responses to my comments.	1	2	3	4	❍
50. ...I feel more comfortable disagreeing with the instructor.	1	2	3	4	❍
51. ...I am at a disadvantage, because I do not possess adequate computer skills.	1	2	3	4	❍
52. ...I at a disadvantage because I do not possess adequate typing skills.	1	2	3	4	❍
53. ...I spend more time studying.	1	2	3	4	❍

Indicate how strongly you agree or disagree with each of the following statements:
(Circle the appropriate number, from 1, strongly agree, to 4, strongly disagree or select no basis for judgment.)
The technologies used in this course (the E-mentoring Web site and the World Wide Web):

	Strongly agree	Agree	Disagree	Strongly disagree	No basis for judgment/ Not applicable
54. ...did not work the way they were supposed to.	1	2	3	4	❍
55. ...were appropriate for performing the tasks required.	1	2	3	4	❍
56. ...were overrated.	1	2	3	4	❍

Thank you for completing this survey.

Appendix H

Post-program questionnaire for mentors

POST-SEMESTER SURVEY: MENTORS

We appreciate you taking the time to complete the following questions. Your answers are important because they may shape the future of the E-Mentoring program by enabling us to build the best E-Mentoring system possible. Thank you very much.

Technology/Information Use

1. How many hours per week do you use your computer for personal, study, or work-related reasons?
   - ❍ Less than 1 hour
   - ❍ 1 to 5 hours
   - ❍ 5 to 10 hours
   - ❍ 11 to 20 hours
   - ❍ 21 to 40 hours
   - ❍ over 40 hours/week

2. How many of the following information resources have you used during the past two months? (Check all that apply.)

   - ❒ Browsed materials in corporate/university library
   - ❒ Studied materials in corporate/university library
   - ❒ Borrowed materials from corporate/university library
   - ❒ Photocopied materials from corporate/university library
   - ❒ Searched online library catalog
   - ❒ Searched for scholarly/professional materials in printed abstract & index services
   - ❒ Searched for scholarly/professional materials via CD-ROM databases
   - ❒ Searched for scholarly/professional materials from the World Wide Web
   - ❒ Received preprints or drafts of papers from colleagues/professors
   - ❒ Shared scholarly/professional interests with colleagues/peers in face-to-face communication
   - ❒ Shared scholarly/professional interests with colleagues/peers in electronic communication

Effects of the E-Mentoring Program

3. How were the students affected by their interactions with you or their participation in the E-mentoring program? (Select from the items below the top three items that you believe represent the greatest impact areas.)

   - ❒ Increased interest in science
   - ❒ Increased science proficiency
   - ❒ Improved grades
   - ❒ Enhanced career choices
   - ❒ Increased motivation to succeed at school
   - ❒ Increased self-confidence
   - ❒ Increased involvement at school
   - ❒ Increased use of technology
   - ❒ Developed friendship, personal relationship with mentor
   - ❒ Other _____

Rate your level of agreement with each of the following statements:
(Circle the appropriate number, from 1, strongly disagree, to 5, strongly agree.)

		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
4.	My student(s) were interested in me.	1	2	3	4	5
5.	I was comfortable answering my students' questions.	1	2	3	4	5
6.	I am interested in continuing my relationship with my student(s).	1	2	3	4	5
7.	I am interested in meeting my student(s) face to face.	1	2	3	4	5

8. The overall quality of the mentor-student match(es) was _____.

- ❍ very poor
- ❍ poor
- ❍ neutral
- ❍ good
- ❍ excellent

Thank you for completing this survey.

Appendix I

Post-program interview schedules for students and mentors

Post-program Interview questions for students

Introduction

- *Thank you for participating. It's from talking with you and getting your responses on surveys that we learn about electronic mentoring. You're the expert, and we hope to learn from your experiences and perceptions.*
- *As you may remember, last time we talked about finding and using information in general, and then about mentoring and electronic mentoring in particular. And I'd like to follow that same format this time as well. Do you have any questions at this point? Feel free to ask questions as we go along.*

1. What are the two *most* important outcomes of the E-Mentoring Program for you (e.g., something you learned or a way in which it changed your life or direction)?
   Can you summarize how or why that happened? Perhaps a story about something that happened to you would help us understand what you mean.

2. What are the three most important things you accomplished by participating in the program?

3. What are the two *most* frustrating or wasteful consequence of the E-Mentoring Program for you?
   Can you summarize how or why that happened? Perhaps a story about something that happened to you would help us understand what you mean.

4. How has your knowledge and skill level in science been impacted by your mentor relationship? Your knowledge about scientific careers?

5. You have used the Internet in the E-Mentoring program to communicate with mentors, other students, facilitators, and faculty. We'd like your help in understanding the strengths and weaknesses of using this technology.
   - For you, what are the advantages of using the Internet? Can you tell me/us a story that illustrates what you mean?
   - What are the disadvantages of using the Internet? Can you tell me/us a story that illustrates what you mean?
   - Is there anything we might do about those disadvantages or problems?

6. Are you aware of any technical problems that occurred during the E-mentoring project this term? Such as, discussion forums not working, etc.? Were these problems dealt with promptly? Do you have any suggestions for how we can improve our technical support services?

7. What did you think about the Kick-off event? What two things did you like most about the event? What two things would you change?

8. Describe the top two changes you'd make to this program to assist you in your role as a student.

9. If possible, would you choose to participate in this program (or a similar one) next year? [Would you recommend this program to other students? Why or why not?]

10. How would you characterize your mentor?

11. How would you characterize the relationship you developed with your mentor?

What impact do you think you had on your mentor?

12. How has this experience compared to other experiences you've had in courses? With mentor programs?

13. Is there anything else you would like to tell me about your experience with the E-mentoring program?

19. Is there anything else you would like to ask me?

Thank you very much! I appreciate your time and your willingness to discuss these things with us. It will help us design and plan future e-mentoring programs as well as better understand what impacts these types of programs have or don't have.

Post-program Interview questions for mentors

Introduction

- *Thank you for participating. It's from talking with you and getting your responses on surveys that we learn about electronic mentoring. You're the expert, and we hope to learn from your experiences and perceptions.*
- *As you may remember, last time we talked about finding and using information in general, and then about mentoring and electronic mentoring in particular. And I'd like to follow that same format this time as well. Do you have any questions at this point? Feel free to ask questions as we go along.*

1. What are the two *most* important outcomes of the E-Mentoring Program for you (e.g., something you learned, or an outcome your interaction with a student had, or a way in which it changed your thinking)? Can you summarize how or why that happened? Perhaps a story about something that happened to you would help us understand what you mean.

2. What are the two or three most important things you accomplished by participating in the program? [different wording previous question]

3. What were the two *most* frustrating or wasteful consequence of the E-Mentoring Program for you? Can you summarize how or why that happened? Perhaps a story about something that happened to you would help us understand what you mean.

4. From your perspective, has your student's knowledge and/or skill level in science been impacted by the mentor programming? How? His/her knowledge about scientific careers? How?

5. You have used the Internet in the E-Mentoring program to communicate with students, and possibly other mentors, facilitators, and faculty. We'd like your help in understanding the strengths and weaknesses of using this technology.
   - For you, what are the advantages of using the Internet? Can you tell me/us a story that illustrates what you mean?
   - What are the disadvantages of using the Internet? Can you tell me/us a story that illustrates what you mean?
   - Is there anything we might do about those disadvantages or problems?

6. Are you aware of any technical problems that occurred during the E-mentoring project this term? Such as, discussion forums not working, etc.? Were these problems dealt with promptly? Do you have any suggestions for how we can improve our technical support services?

7. What did you think about the Kick-off event? What two things did you like most about the event? What two things would you change?

8. Describe the two most important changes you'd make to this program to assist you in your role as a mentor.

9. If possible, would you choose to participate in this program (or a similar one) again? [Would you recommend this program to other students? Why or why not?]

10. How would you characterize your student(s)?

11. How would you characterize the relationship you developed with your student(s)?
    Would you like to continue interacting with your student(s)? If so, have you discussed this with your student(s)? What impact do you think you had on your student(s)?

12. What sort of impact has your student(s) had on you? What have they taught you?

13. How has this experience compared to other experiences you've had mentoring or working with students or interns?

14. Is there anything else you would like to tell me about your experience with the E-mentoring program?

20. Is there anything else you would like to ask me?

Thank you very much! I appreciate your time and your willingness to discuss these things with us. It will help us design and plan future e-mentoring programs as well as better understand what impacts these types of programs have or don't have.