Mentoring in a School Environment

Shanan Gibson

Department of Psychology, Virginia Tech, Blacksburg, VA 24061

Dennis C. Neale, John M. Carroll, Christina A. Van Metre

Center for Human-Computer Interaction and the Department of Computer Science, Virginia Tech, Blacksburg, VA 24061

Abstract: We describe how the integration of multiple computer-mediated communication and collaboration technologies can support educational activity through mentoring in a local community context. We discuss the student and mentor expectations, their ongoing relationships, and the role that technology has played throughout their interactions.

Keywords: mentoring, telementoring, computer-mediated communication

Introduction

In recent years, mentoring has received much recognition as a means of fostering student development. Mentoring has been shown to be reciprocally beneficial to both students and mentors. It is claimed that these mentoring relationships benefit students through performance support and conveyed knowledge, through increased self esteem evoked by involvement in developmental relationships, and through clarity in communicated project and work goals (Gaskill, 1993). Young people who are mentored by community members are more likely to stay in school, attend classes, achieve and aspire to better grades, and go to college (Proctor and Gamble, 1988). Mentors report deriving satisfaction from having a positive impact on studentsí learning and interests in academics, self-confidence, and through "getting to know" the students involved. Furthermore, it is likely that individuals serving as mentors will develop a better understanding and appreciation of the educational needs of todayís students and teachers (HP Telementor Program, 1999).

Much of the current research on mentoring has focused on informal, spontaneous relationships that evolve between individuals (Gaskill, 1993). However, this is not always a viable approach in a school environment; indeed it has been argued that the best mentoring programs are designed, not left to chance, and that a well-designed mentoring program offers the greatest opportunity for student development and benefit (Mann and Staudenmier, 1991 and Lawrie, 1987). Many factors can impede the development of effective mentoring relationships: time constraints, geographic location, convenience of interactions, visibility of results, and effective evaluation of project focus and structure.

The Learning in Networked Communities (LiNC) project integrates multiple computer-mediated communication and collaboration applications in order to address some of these issues that might encumber the mentoring process. The following paper provides an overview of the project, student and mentor expectations, and the relationships developed during the mentoring activity. It discusses the role computer-mediated communication plays in this educational setting and proposes some future work and issues to be addressed.

Overview and Goals of the LiNC Project

The LiNC project is investigating ways in which technology-based collaborative tools can support educational activities. A major component of the project has been fostering mentoring relationships in a local community context (Carroll & Neale, 1998). By seeking to utilize and develop the networking infrastructure of the Blacksburg Electronic Village, an advanced community network in southwestern Virginia (Carroll & Rosson, 1996), it is hoped that school-based learning will be made more meaningful as it is joined with the proximal community in which students reside.

The LiNC project involves four schools and teachers, consisting of two middle-school physical science teachers, and two high-school physics teachers. One school at each level is "rural," and the other is located in a town. The chief objective is to understand how to use computer-based communication and collaboration technology to promote effective collaborative relationships among students within a classroom, across students in different classrooms, and between students and community mentors. The project is strongly committed to a participatory investigation among public school educators and university researchers. We believe it is both appropriate and realistic for the educators to exert prerogative in the area of pedagogical practice (Tyack & Cuban, 1995), and as a consequence of this, the implementation of the mentoring initiatives has varied somewhat among the classrooms.

During the 1998-99 school year, and consistent with the prior year, an emphasis was placed on sustained collaborative projects as a teaching mechanism. Student groups work over a period of four months to complete physics-based science projects, with many of these targeted at springtime academic fairs and other events that involve presenting schoolwork to parents and other community members; these projects are currently ongoing. Teachers had incorporated community mentors into similar projects during the 1997-98 school year and were predisposed to do so this year as well. It was anticipated that the incorporation of mentors would add validity, relevance, and context to the classroom science projects, augmenting the traditional science learning (Glasgow, 1996).

Technological Tools

The educational technology focus of the LiNC project includes an ensemble of technological communication and collaboration tools called the "Virtual School," a Java-based environment supporting coordinated synchronous and asynchronous planning, note taking, experimentation, and report writing (Koenemann, Carroll, Shaffer, Rosson, & Abrams, 1998). The central tools include e-mail, desktop videoconferencing, chat, a shared whiteboard, as well as a specially created collaborative notebook. The notebook allows students, teachers, and mentors to organize projects into shared and personal workspaces (sections), annotate the work of other group members, and track changes to project notebooks. Both remote and proximal participants can access the notebook collaboratively or individually.

Community Mentors

Teachers established mentoring relations by contacting community members (e.g. spouses of other teachers, parents of former students, or friends from church) and searching Virginia Tech departmental web pages to identify faculty with relevant expertise. Community members with the relevant backgrounds who agreed to participate were invited to an informational meeting where the goals of the project, initial expectations, and the software to be used were reviewed.

The recruited mentors had expertise in a variety of fields, including the mechanics of amusement parks, the engineering principles of bridge building, aerodynamics, robotics building, the principles of acoustics, and physics used for creative engineering. The mentors were each assigned to collaborative student groups and provided with e-mail addresses for contacting the students through the Virtual School. Students were asked to contact their mentors via the Virtual School and e-mail. Table 1 provides an overview of the topics being mentored and the corresponding schools.

Table 1. Overview of Mentoring Topics by School

Mentor/Subject Matter	Location of Collaborative Student Groups
Acoustics	Rural Middle School & Rural High School
Robotics Building	Urban Middle School & Rural High School
Creative Engineering	Rural Middle School & Urban Middle School
Bridge Building	Rural Middle School & Urban High School and Urban Middle School & Urban High School
Aerodynamics	Rural Middle School & Urban High School

Student and Mentor Expectations

A survey taken at the beginning of the 1998-99 school year measured studentsí attitudes toward mentoring and other collaborative learning relationships transcending the classrooms. Students responded on a seven-point Likert-type scale to the following statements:

- I would enjoy having a mentor for my group project who is from the community, not my school.
- I would enjoy interacting with students from other schools on my group science project through the Virtual School.

Results indicated that across all schools the students were positively disposed toward working with a mentor. In excess of 50% of the students responded above the hypothesized mean of four (the midpoint of the scale) to the first question, and only 26% responded below this. Comparisons among schools, grade levels (middle vs. high), setting (rural vs. urban), gender, and a level by setting interaction were conducted. No significant differences were found between the four schools, settings, genders, or grade levels. There was a significant interaction effect, however, of setting by grade level with the urban high school students responding most positively to the statement ($p < .05$). Similar, but more highly positive, responses indicated that students were enthusiastic at the prospect of working with students from other schools. Over 63% of the students responded above the mean of four to this item, and only 18% responded at the low end of the scale. No significant differences were found for any comparisons conducted.

Prior to the full-fledged kick-off of the studentsí science projects, both students and mentors were contacted by e-mail to gather feedback regarding their expectations and plans for the ensuing relationships. Across all of the student groups, several themes were repeated. Namely, students perceived the mentors as "experts" who could help them with understanding and applying the appropriate physics concepts to their science projects. The students also expected assistance in designing the actual physical models required for their projects. Students also stated that they had a responsibility to uphold communications, keep mentors informed, and be polite and reasonable with all requests. These statements were consistent with instructions given to the students by teachers at the beginning of the projects. The studentsí expectations for mentoring outcomes were universally positive.

Mentors were also positive in their expectations. Several mentors had prior experience working with students and looked forward to the interaction, anticipating it as "enjoyable". A desire to have "fun" while "showing the value of experiential learning" was also expressed. Mentors who had worked with students from the LiNC project last year had more specific expectations, including receiving feedback on mini-assignments that they were giving the students, and monitoring of the mentoring relationships by teachers. In all instances, mentors felt that they could positively impact the studentsí collaborative science projects.

The Mentoring Relationship

Both students and mentors were diligent in initiating contact via e-mail. The mentors all began with brief introductions as well as a synopses of their affiliations and expertise. Two of the mentors also expressed their enthusiasm for the projects and their desire to work with the students, but they did not broach the subject of actual work. Two other mentors, however, immediately began providing structure for the students by attempting to narrow the focus of the groupís work and by assigning mini-experiments in the subject matter. The fifth mentor was a bit slower in contacting his groups, but once he did so, he incorporated both strategies in his initial e-mail. Students generally introduced group members, expressed their pleasure at having a mentor, and proceeded directly to questions of project relevance. Examples included: "How is the angle of the first hill determined so that the train (roller coaster) has enough energy to make it through the ride?" and "We were wondering if you had any information on Web sites on (stereo) speakers."

Despite this initial enthusiasm in the mentoring endeavor, several of the relationships later became plagued by lack of communication. Mentors also had difficulty videoconferencing from remote locations due to a newly installed firewall in the public school system. As a result, videoconferencing occurred primarily among the students, and mentoring interactions were relegated to e-mail and chat within the Virtual School. The exception to this was one mentor who traveled each week to one of the local schools in order to participate in the videoconferencing and assist the younger student in the project group.

The lack of videoconferencing capabilities, however, was not the only barrier to the mentoring relationships. An interesting example involves the interaction between the mentor and the students engaged in a bridge-building project. The mentor involved in the bridge-building project worked as a LiNC mentor during the previous school year, and his mentoring relationship has been characterized as the most successful observed. According to Carroll and Neale (1998) "this relationship was initiated via e-mail but became rich and successful through direct face-to-face interaction. The student working on a bridge project contacted his mentor at Virginia Tech, and through discussions about the project, they discovered they lived in the same neighborhood. They developed a friendship, and the student visited the mentor many times through the course of the project. They actually built model bridges together at the mentorís home. The studentís teacher commented that rarely did she see the enthusiasm and knowledge developed by this student for his science project, and it resulted from the mentoring process. Although one could imagine being able to do similar activities with videoconferencing, the experience would not have been as rewarding for the student or mentor, nor would the relationship have likely progressed to this level. Notably, e-mail enabled this relationship and subsequently helped facilitate face-to-face communication as the project proceeded."

During the current school year, the bridge-building mentor began working with his two new groups in an extremely proactive manner, not only explaining the physics concepts to the students but also suggesting ways in which they could replicate them in the classroom. However, the students this year did not actively engage in the interaction and did not respond to the mentorís suggestions. This prompted the mentor to infer that the students did not need nor want his assistance. He stated that he was "without feedback from either bridge group" and that "an e-mail on their progress would be nice." However, he did have access to their work through the Virtual School. Despite attempts to re-engage students in the interaction and make teachers aware of the current situation, the mentoring relationship did not regain momentum. This example suggests that something more than access to student work and encouragement may be necessary to sustain successful mentoring relations.

Unlike the two bridge building groups, two other project groups developed very strong mentoring relationships. Although these groups also relied upon the Virtual School technology in their endeavors, they also had a face-to-face component in their relationships. The acoustics project group initially communicated only through e-mail with their mentor. However, a few weeks into the project, the mentor made a trip to the studentsí classroom and gave a lecture on the physics of acoustics. Although the students expressed concern that the content of the lecture may have been too difficult, this meeting provided much fodder for future electronic meetings and the nature of the relationship continued to grow. Following up with the students, the mentor made a second trip to the school in which project plans and goals were clarified, and students gained a better understanding of the physics concepts in question. The students in this group have also had the opportunity to work with their mentor in an acoustics laboratory at VA Tech. This mentoring relationship continues to be characterized by frequent e-mails in addition to the face-to-face interactions even as the science project comes to a close. This mentor continues to play a central role in helping develop a classroom demonstration of the principles studied.

The mentoring relationship in the robotics group is characterized by a mix of electronic and face-to-face interactions that is fully enabled by the technology used by the students during group collaboration. This mentor regularly visits the classroom of the middle school group member and sits with her as she videoconferences and chats with her group members at a remote high school. The remote group members can see and speak with the mentor through videoconferencing and chat with him through text. This relationship further developed because students from the remote group were able to meet face-to-face with the mentor at the Virginia Tech Robotics lab. The relationship between the mentor and students appears strong in this instance, as evidenced by the impact the mentor has had in developing the project and the continued number and content of interactions. The use of e-mail is infrequent in this relationship, possibly because it is unneeded. Non-verbal communication is occurring synchronously via chat, and face-to-face interactions have allowed for verbal interaction. An educational, and perhaps social, consequence of this relationship concerns the extent to which the middle-school student has become reliant on the mentorís feedback and project suggestions. When the mentor is present, the student tends to take less solo initiative with her group teammates. However, following the studentís visit to the Robotics Lab, there has been some abatement in this. This mentor continues to help the students in designing the actual robot, and further engages their interests by bringing working robots to the classrooms for demonstration. Clearly, this mentorís physical presence has transformed the group interactions.

Visibility, a major theme in telementoring research, has been hypothesized to be the key ingredient in sustaining successful telementoring relationships. It has been posited that providing mentors with the ability to view their protégéís work promotes sustainable telementoring relationships (OíNeill & Gomez, 1998). Visibility did not appear to be sufficient for sustaining relationships in this project. Table 2 shows mentor activity in the

Virtual School applications. Each mentor engaged in a similar number of the activities associated with viewing student work; however, actual mentoring communication (measured as the number of chat messages sent) is highly skewed toward the Acoustics mentor. This mentor also engaged in face-to-face communication with his students. Furthermore, an examination of the content of the chat messages sent by the Acoustics mentor, shows significantly richer interactions such as sharing project information, providing project feedback and giving support and reassurance.

Table 2. Virtual School Activity by Mentor

Mentor / Virtual School Activity	Acoustics[1]	Robotics [1,2]	Bridges	Creative Engineering	Aerodynamics	Total
VS Log-In	13	N/A	15	8	13	49
Opened Notebook	5	N/A	9	6	2	22
Entered Chat	4	N/A	6	1	1	12
# of Chat Messages Sent	101	N/A	3	7	2	113
Total Activities	123	N/A	33	22	18	196

[1] Designates those groups that incorporated a face-to-face aspect to the mentoring relationship

[2] This mentor did not log-in or utilize the software externally because he was present in the classroom during Virtual School activities

Table 3 summarizes the number of e-mail interactions as well as the theme of the messages across all of the groups. The two groups that had face-to-face interaction with their mentors not only had a larger number of communications, but the kinds of communication engaged in appear to be quite different. It makes sense that these groups would need to devote a considerable amount of time to coordination and scheduling of meetings; 53% and 44% of the e-mail for the acoustics and robotics groups contained this theme. What is surprising; however, is that these are the only groups whose e-mails contained themes related to providing moral support, requests for feedback on work, and actual feedback on the project work. These are areas that one would assume to be major emphases in all mentor-protégé relationships, providing the foundation on which the relationships build. It appears that in the absence of personal contact, a rich give-and-take mentoring relationship did not develop.

Table 3. Comparison of E-Mail within Group, by Theme

Group / E-Mail Correspondence Theme	Acoustics[1] Count Percent	Robotics[1] Count Percent	Bridges Count Percent	Creative Engineering Count Percent	Aerodynamics Count Percent	Total Percent of Total
Salutation	3 8%	3 19%	1 14%	3 50%	2 33%	12 16%
Project Information	5 13%	4 25%	3 43%	0	1 17%	13 18%
Project Information Request	5 13%	1 6%	2 29%	2 33%	2 33%	12 16%
Coordination or Scheduling Issue	20 53%	7 44%	0	1 17%	1 17%	29 40%
Project Status Update	7 18%	4 25%	5 71%	2 33%	1 17%	19 26%
Support and/or Reassurance	3 8%	1 6%	0	0	0	4 5%
Project/Work Feedback	2 5%	1 6%	0	0	0	3 4%
Project/Work Feedback Request	2 5%	1 6%	0	0	0	3 4%
Actual E-mail Count	38	16	7	6	6	

[1] Designates those groups with a face-to-face aspect to the mentoring relationship

Discussion

The nature of the relationships propagated by technology emphasizes the role of face-to-face interactions in establishing successful computer mediated mentoring relationships. The contrast between the mentoring relationships developed in the bridge-building project and those in the acoustics and robotics projects, clearly speaks to the visibility of the members in the mentoring relationship, not simply the work. The aerodynamics mentor from the 1997-98 school year felt that his initial face-to-face meeting helped make subsequent interactions effective by allowing him and the students to more vividly imagine the other people with which they were communicating (Carroll and Neale, 1998). Likewise, the acoustics and bridge-building mentors this year have fundamentally transformed the nature of their mentoring interactions by meeting and working face-to-face with the students.

In general, the relationships characterized solely by electronic interaction had fewer interactions of any type occurring, and those that did occur appeared to be less rich in nature. Face-to-face interactions appear to have facilitated mentoring by computer-mediated channels. Those students who were not able to meet face-to-face with their mentors were not successful in maintaining their telementoring relationship. One possible explanation for this is that the computer-based communication was novel in the mentoring relationships, and lacked a history of social cues and shared experiences that could have made it more fruitful (Sproull and Kiesler, 1991). Although all students were provided with valuable information for their projects, the mentors who were completely reliant upon computer-mediated communication had significantly less impact in focusing the groups' work and the final outcomes of the science projects.

The ability to exploit videoconferencing more fully may help to alleviate some of the difficulties of sustaining a successful telementoring program. In follow-up interviews, the Acoustics and Robotics mentors stated that they believed the ability to videoconference from their offices would have lessened the need for face-to-face interactions; however, they do not believe it would have removed it entirely. For those mentors who had no face-to-face contact with their protégés, videoconferencing may have provided the impetus to more fully develop their relationships.

Future Work

As the science projects begin to culminate, so do the mentoring relationships. Students are finishing their work, and teachers are advising them to send e-mail to their mentors thanking them for their assistance during the past several months. As most interactions are still ongoing, summative conclusions about the outcomes of the project are tentative. Future analyses will include quantification of the various mentoring interactions (e.g., e-mail, chat discussions, annotation of course work, and face-to-face meetings) as well as conducting interviews and surveys to ascertain the perceptions of the mentors, students, and teachers involved in the project. It is anticipated that this information will guide the implementation of the mentoring program next year, serving as a "needs-analysis" that may point toward better training of mentors and students in use of the technology, expectations for the relationship, and role-clarification for all involved.

Although computer technology has played a major role in the relationships examined during the 1998-99 school year, the face-to-face contact remains critical. Face-to-face meetings provide an array of physical and social resources to aid in the coordination of group work. Visual and verbal presentations, taken together, allow dimensions of clarity that written presentation does not afford (Olson et al., 1993). One of the challenges faced by computer-mediated communication is how to make distributed interactions as effective as face-to-face interactions (Ellis et al., 1991). Since most mentors were unable to use videoconferencing throughout this project, it will be interesting to observe the effect videoconferencing has on the student-mentor relationship in future projects. We believe that videoconferencing can provide some of the resources of face-to-face communication. Further exploration of how to integrate and supplement face-to-face communication will be a central theme during the coming school year.

All participants involved in the mentoring relationships recognized the potential value of working together. The technological tools used in this project, while reducing the constraints of physical proximity, also created second-level interpersonal implications that will need to be considered more fully in the future (Sproull and Kiesler, 1991). Thus, a major challenge in coming years will be determining how to best utilize a mixture of computer-supported technology and traditional mentoring methods to achieve the greatest return for all participants.

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Authors' addresses

Shanan Gibson (shanan@vt.edu)
Department of Psychology, Virginia Tech; 5088 Derring Hall, Blacksburg, VA 24061-0106. Tel. (540) 231-6581. Fax (540) 231-3652.
Dennis C. Neale (dneale@vt.edu), John M. Carroll (carroll@vtopus.cs.vt.edu), & Christina A. Van Metre (cvanmetre@vt.edu)
Center for Human-Computer Interaction and the Department of Computer Science, Virginia Tech; 660 McBryde Hall; Blacksburg, VA 24061-0106. Tel. (540) 231-6931. Fax (540) 231-6075.