Is everybody happy? Bridging the perspectives and developmental needs of participants in telementoring programs

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> People can play a role in social processes with someone else only to the extent that they comprehend the other's frames of reference, meaning and talk. It is that extent of comprehension that effectively determines (in the sense of limits) the boundaries of the relationship they each have with the other. (Duck 1994, p. 54)

Introduction

Knowledgeable adults working and learning outside the school system have a lot to contribute to the education of our children. For many years, teachers have invited parents and community volunteers into their classrooms from time to time for activities like science fair judging or "career day". But during such rare and sporadic visitations, even very knowledgeable adults cannot have much influence over the subjects that students can study deeply, or the understandings they can construct of these subjects. For the most part, brief expert visits reinforce traditional pedagogies that we know fail children on a number of counts (Scardamalia & Bereiter, 1997).

The Internet now makes possible much deeper and more routine influences between schools and adult work environments in which learning has a high priority. In recent years, researchers of on-line mentoring, (or “telementoring”) have achieved considerable success in their efforts to engage K-12 students and knowledgeable adult volunteers from around the continent in long-term, curriculum-based on-line relationships (Bennett, Hupert, Tsikalas, Meade & Honey, 1998; Bennett, Hupert, Tsikalas & Meade, 1997; Dimock, 1997; Ferneding-Lenert & Harris, 1994; Harris, Rotenberg & O'Bryan, 1997; O'Neill, 1997, March; O'Neill, 1998; O'Neill & Gomez, 1998, November; O'Neill & Scardamalia, 2000; O'Neill, Wagner & Gomez, 1996; Sanchez & Harris, 1996). The common purpose of these efforts, and of the volunteers involved in them, has been to enable teachers and students to pursue more ambitious classroom inquiry than they would find feasible by themselves. Because many adults find it more practical to share their expertise on-line than by visiting schools in person, telementoring is a practical way to give students and teachers expanded opportunities to engage as legitimate peripheral participants (Lave & Wenger, 1991) in communities of practice beyond the confines of the school.

A promising literature has developed from research on telementoring programs. Through a combination of content analyses of mentor-mentee correspondence (Ferneding-Lenert & Harris, 1994; Harris & Jones, 1999; O'Neill, 1998), case studies (O'Neill, 1998; Sanchez & Harris, 1996), and cross-case analyses (Dimock, 1997; Ferneding-Lenert & Harris, 1994; McGee, 1998), a good deal has been learned about the nature of telementoring relationships, and how to make them

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successful. Armed with these findings, researchers are now focusing greater attention on understanding what will be necessary to bring telementoring programs to scale.

Despite the encouraging degree of success in telementoring initiatives, we believe that future ventures will be limited by scholars' understanding of the expectations and ideas that participants (including students and mentors) bring to their work on-line. How these expectations and ideas lead participants to interpret and respond to the experiences they have together can, and should shape the design of telementoring programs; and while there cannot be a single authoritative answer to questions as broad as "what do mentors want from telementoring?" and "what do students want from telementoring?", there is now a large enough body of experience that we can begin to characterize the range of expectations that students and volunteers carry into their experiences of telementoring.

Over the past several years, we have each worked with teachers, volunteers and students to design, implement, and conduct research on telementoring initiatives. In what follows, we will argue that to fully realize the potential of telementoring, the designers and evaluators of telementoring programs must examine their work through two different lenses: that of voluntarism and that of human development. Telementoring is a new mode of voluntarism which is finding its place in society amid other, more traditional forms; and at the same time it is a new venue for human development, the roles and norms for which continue to evolve and take varied forms.

A new mode of voluntarism for education

To appreciate what telementoring is and how it works, it is important to understand how it differs from ways that knowledgeable volunteers have more commonly been involved in Education. Community involvement is often argued to be a necessary ingredient in real and lasting school reform; but not all forms of community involvement are alike, or are of equal benefit to students' subject-matter learning. If they are not taking part in school governance, attending a school play, coaching the home team, or consulting with their own childrens' teachers, adults most often visit schools to share their knowledge and experiences with students in one way or another. One good way to begin understanding telementoring is to understand how it differs from other volunteer activities in education; because in order to do telementoring well, volunteer mentors often have to "unlearn" or recontextualize what they know about more traditional forms of voluntarism.

Ask-an-expert

One traditional way for adults to become involved in education is through question-and-answer sessions. For example, a representative from a local company might visit several classrooms in a school to talk about careers in his or her industry. The visitor might make a brief presentation, then take questions from the students and their teacher. These kinds of visits can be quite worthwhile, but they have important built-in limitations, as one of the teachers involved in O'Neill's work (O'Neill, in press) explained in an interview:

> It's a very limited amount of time in your students' [lives]. For instance [a program I'm familiar with] sent lawyers into the classroom. And this is a very nice program, they'd be there every week for a period, over three weeks or four weeks. But what if the kid, in the interim, thought of something, or had a dimension that they wanted to talk about? If the classroom teacher wasn't in a position to discuss it with them, or didn't have the knowledge to discuss it with them, then it was on hold for a week. [It's important to take advantage of the student's curiosity] before it diminishes in their view of things that are crucial and important.

Because it is not practical for many adults to visit schools on a regular basis, a number of professional organizations have developed on-line services that allow students and teachers to get factual questions answered by a knowledgeable adult, much in the way they would during a one-day, in-person visit. A variety of these "Ask-a" services can be found on the Internet today: Ask-a-Geologist, Ask-a-Librarian, Ask-an-Astronomer, and so on. Again, these services can be quite useful; but they have important limitations.

The first limitation of Ask-a services is that they can only provide answers to factual questions. While this is handy for students working on a traditional book report, it is not very useful when they are addressing complex questions or more challenging open-ended investigations — practices which many reformers and learning scientists now advocate. Second, by their nature Ask-a services do not give students the opportunity to develop ideas with a more knowledgeable adult over time. They are built to provide the most accurate answer possible to each individual question they take in, by routing it to the person who is most likely to possess a particular piece of knowledge. As a result, the question that a student submits today and the question he or she submits tomorrow will most likely go to two different people. The possibility of students developing a complex idea under the guidance of a single knowledgeable adult is essentially designed out; and so is the satisfaction that the adult can gain from watching students' ideas develop over an extended period of time.

One-time Judging

Another way that knowledgeable adults have traditionally been involved in schooling is to judge and offer feedback on student's work during competitions. For example, adults from the community around a school might serve as judges for a science fair or a public speaking contest. In both science fairs and public speaking contests, students prepare a complex product or performance over a relatively long period of time. Finally, after a lot of largely independent work, students get feedback from adult judges who are chosen to personify professional or semi-professional standards.

One problem with this arrangement is that it is a bit unfair to some students. While some students' parents did quite well in school themselves and can offer good guidance, many others will toil away at home, in ignorance of the standards they will ultimately be held to. Another problem, which hurts nearly all students, is that these professionally-judged competitions leave a lot to be desired as learning opportunities. The reason is simple. Because science fairs and public speaking events are arranged as contests, by definition the majority of students will not get to "perform" more than

once. This means that they will not have either an opportunity or an incentive to apply the feedback they get from the judges, no matter how effective or insightful it may be.

Tutoring

One final way that knowledgeable adults traditionally to get involved in education is through tutoring. Many of us have had experience with tutoring at some point in our lives, and will probably agree that it is a wonderful way to learn when you have a well-identified learning need. Tutors can also have beneficial effects on students' motivation by reducing the likelihood of floundering during problem solving (Merrill, 1992).

Tutoring is often confused with mentoring because unlike one-time judging or ask-an-expert arrangements, it involves a kind of ongoing relationship between a student and a more expert person. But there are important differences between tutoring and mentoring. One of the biggest has to do with the source of the problems that the student and the expert work on together. In tutoring, the expert assigns the student a problem or task (say, a geometry proof), and the student performs it under his or her watchful eye. The expert then evaluates the student's performance, provides some on-the-spot instruction, and assigns a new task. Sometimes the task is a more difficult one, sometimes it is easier, and sometimes it is at the same level of challenge (for practice). In any case, the tutor is in complete control of which problems the student works on, and when.

Mentoring

Mentoring is quite different from tutoring because *the student brings the problems to the table*. Whether they are practical problems (e.g. where to find information resources for an investigation), intellectual problems (e.g. how to design an investigation that will produce valid and interesting results), or something in between (designing an investigation that both makes sense and is do-able in a particular time frame), *the problems belong to the student*. The mentor offers advice, guidance and support; but it is up to the student (or students) to take it and carry it out. In this way, telementoring has a natural affinity with curricula that seek to cultivate greater self-management of learning.

The idea of mentoring itself dates back to the ancient Greek poet Homer, and his epic work, *The Odyssey*. In the poem, Odysseus' son Telemachus is given guidance by a wise old sea captain named Mentor about how to cope with the consequences of his father's long absence since the Trojan war. Today, the term "mentor" is used to describe people in a wide variety of both pre-arranged and spontaneous relationships in school and business communities. While researchers (and the general public) tend to differ on what they mean by the term, "mentoring" generally denotes a supportive relationship between an older, more experienced person and a younger protégé that serves to initiate her into a new profession, organization, or stage in life.

In the field of education, formal mentoring programs have been created a) to advise and support teachers in the early years of their careers (e.g. (Little, 1990)); b) to support the development of

students in traditionally disadvantaged groups (e.g. (Tomlin, 1994)); c) to bring adult professionals to classrooms on a regular basis (e.g. (EDC, 1994)); or d) to bring students into laboratories or other adult workplaces periodically (e.g. (Waltner, 1992)). Outcomes are as diverse as the programs themselves. Unfortunately, many worthwhile mentoring programs have not become widespread enough to have much influence on how students' are educated in core subjects such as science. This is partly explained by the fact that they require unusual resources or entail large disruptions in the customary work routines of the volunteers.

Curriculum-based Telementoring

One of the most compelling reasons to orchestrate mentoring relationships for students on-line is to take greater advantage of the personal interests and curiosities that can bring students to engage deeply with subject-matter. All teachers know that students learn best what they are curious about; but even when teachers can afford to give students the freedom to explore their curiosities (for example, in science projects), the limits of their own time and expertise might make it necessary to confine their students' research to a narrow set of subjects to ensure that students are well supported and produce quality work. Appropriate telementors make it more practical for teachers to let students to pursue a variety of curriculum-related interests at the same time: one team researching earthquakes, another black holes, another the swimming motions of the plesiosaur. The added variety in students' work hightens interest for both students and teachers.

As the next sections will illustrate, an important part of what a telementor does is facilitate students' best thinking by "problematizing" work which they might otherwise approach in a simplistic way. As most teachers know who have tried to give students greater control over their own learning, inexperienced investigators often bite off more than they can chew, or trim a problem down to trivial proportions. One of O'Neill's teacher collaborators, Whitcomb, once explained how the participation of telementors in students' work can motivate their efforts toward understanding:

> I'm hoping that by being involved with [their telementors], that they're putting [their work] out there for someone else, one, that they're going to be a little more critical of themselves, because it's not me that they've known for three years and they know that if they smile nicely I won't get so mad about it.... They'll have somebody new that they're presenting it to, and somebody who will give them a *different* kind of feedback than the feedback I've given them.

A telementors' role as a responsive and critical audience for students' work does seem to make a difference. In a study of one mature implementation of telementoring, O'Neill found that students who put forward greater effort to sustain their mentoring relationships over the course of their projects were significantly more likely to use sophisticated argument strategies in their final reports. In particular, they were more likely to anticipate possible objections to their work and weigh perspectives even-handedly (O'Neill, 1997, March; O'Neill, 1998). Most important, "good" students were not the only beneficiaries of this effect. Neither students' argument strategies nor their effort in sustaining their mentoring relationships were significantly correlated with their grades on a traditional content test.

A Telementoring Relationship

Closer examination of one telementoring relationship may help clarify the benefits we have been describing. Another of O'Neill's collaborators, Wagner, teaches Earth Science to mixed classes of 9th-to-12th grade students at a Chicago-area high school. Generally, these classes are populated by "science avoiders" seeking to satisfy a minimum requirement for graduation. Wagner's strategy to motivate them is to let them study deeply whatever most interests them within the scope of his course, from stars and black holes to garbage dumps and the extinction of the dinosaurs. However, he imposes strict requirements on the methods and reporting of their research, and expects more thorough and original work than he would for shorter-term projects (O'Neill et al., 1996; Polman, 2000).

In the final quarter of the 1995/96 school year, two students in Wagner's class decided to do a research project on earthquakes. Wagner matched this team with a Geology graduate student who we will refer to as Mandy[1]. The following excerpts from Mandy's e-mail exchanges with the earthquakes team illustrate a few of the kinds of support and guidance, both intellectual and emotional, that a telementor can provide for students. (Note: A ">" at the beginning of a line indicates a quotation from the previous message in the exchange.)

The relationship began with a fairly typical "hello" message:

> Date: Thu, 2 May 1996
> Dear Mandy,
> We are juniors at Lakeside High School. We are participating in a group project involving earthquakes. Your help would be greatly appreciated. Our project is due on May 17.
> Yours Truly,
> Marilyn and Robert

Marilyn and Robert's initial greeting received a prompt and friendly reply. In it, Mandy attempts to help Marilyn and Robert set an agenda for their work. She cautions them about the shortness of their schedule, but tries to inspire confidence as well:

> Date: Sat, 4 May 1996
> Dear Marilyn and Robert,
> Hello and welcome! Glad to hear from you. I'm really excited about working with you on this project.
> > Our project is due on May 17.
> Whew! Tight timeline, but I'm sure we can make it. My help is at your disposal. What aspect of earthquakes are you interested in? We first need to define the question/info that best grabs your interest, and then we can formulate a "research attack" plan for the project.

[1] A pseudonym. Throughout this article, only the two teachers are referred to by their real names. They have given their consent to be identified.

Draft a few ideas down on paper, then e-mail me back with the info. Once we have a good topic, we can hit the ground running.

If you're short on ideas, grab the local paper or the Tribune, or news magazines like Time, Newsweek, or even Discovery. With the recent earthquake in the Pacific Northwest, I'm sure the media has cooked up a few articles with cool graphics.

After this message, five days elapsed in which Robert and Marilyn brainstormed ideas for their project. This can be a very time-intensive process, since students must consider not only what they are curious about, but which of their curiosities can most likely be addressed to their teacher's satisfaction using available data. At the end of the five days, Robert broke the silence with Mandy by reporting the question that he and Marilyn had come up with:

Date: Thu, 9 May 1996
Dear Mandy,

I'm sorry about not really corresponding with you as much as I should... I'm starting to get nervous about not completing much on our project so far. The following is the exact question we are researching: Where and why do the largest earthquakes occur? Please write back. Thanx.

Your friend,
Robert

At this point in their exchange, Mandy sent Robert and Marilyn a long message suggesting a four-step process to completing their project. The steps, as she worded them, were:

1) Learn about earthquakes: what causes them and the three types of faults
2) What causes earthquakes: this is due to plate tectonics and you need to learn about the three plate boundary types: convergent, divergent, and strike slip...find out which one causes the deepest and strongest earthquakes
3) Where do the strongest EQ occur: find a world-wide map with dots showing the distribution of EQ the last decade or so. There are a few on the net but any intro Earth Science textbook should have such a map. Your local library has to have a text with it (school or city public library).
4) Match plate boundary location with the location of the strongest EQ: in doing this, you have defined the cause for the strongest EQ.

Robert was so impressed with this plan that in his next message, he expressed some concern about the amount of time that Mandy might be taking away from her job to help with his project. He also informed Mandy that the deadline for his final report had been extended. Note that in her response Mandy shares his relief, but stresses the importance of making good use of the additional time. She also requests a summary of the work he and Marilyn have done so that she can continue to offer informed advice:

Date: Tue, 14 May 1996
> It's me, Robert. I want you to know that I did get your rather large message sent
> on Friday. It will be very helpful.

> Thank you very much. Our new due-date is Monday, May 20, instead of Friday.

Alright! Deadline extensions are always a great feeling. Together we'll make sure to make the best of it!

As to the "four step plan", the approach is really that simple. And if you hit a stumbling block, just e-mail (or in last ditch effort as the deadline nears and you don't have computer access....call) because I have a small confession to make...I already know the answer to your thesis question. The steps I outlined last week are the exact same steps I put my undergraduates through to answer the same question within a 50 minute lab. They have it easier since I provide all the necessary references; you have to find them on your own.

E-mail a quick research summary the next time you get on the computer; that way I know where you are and can drop suggestions to make sure your time isn't lost on unimportant sidetracks.

Another confession....it doesn't take me that long to write these letters, so please don't worry about that. ...It's...my "job" to help you though as much of the research snarls that I can for your project. I'm a teacher here at the university, and I make myself available to my students anytime during the day, except after Letterman has read the Top Ten :-)

If you want me to read your paper before you turn it in, just attach it to an e-mail message and I'll review it and e-mail back suggestions.

Talk to you tomorrow, Robert -- Mandy

Three things are important to note about this message and the dialogue as a whole. First, this dialogue between Mandy and her mentees is driven by the project requirements and deadlines that the teacher has put in place. These both stimulate conversation and provide a common frame of reference in which the participants can work together to understand and accomplish challenging tasks. Second, Mandy's role is not simply that of an answer-provider; she helps Robert and Marilyn over "snarls" in their work, ensuring that they can exercise intellectual initiative and learn in a relatively independent way, without losing time on sidetracks.

Finally, the kind of personal attention which Mandy provides in this case does not guarantee that students' projects will be successful. The work is still up to them, and it is influenced by factors over which a telementor can have no control. Team partners miss school; they bicker; they fritter away time. The teacher is still responsible for mediating these factors and formally evaluating students' learning. However, with telementors sharing the burden of providing advice and guidance to students, they can often come closer to realizing the full potential of their ideas.

Telementoring as a new venue for human development

While the relationship we explored in the previous section was largely intended to reveal the educational benefits that telementoring relationships can have, it also illustrates a more global point about them. Telementoring relationships draw inspiration from traditional mentoring relationships, and can attempt to emulate them in many ways; but in the end they develop differently and serve different kinds of needs. There are a variety of reasons for this, some of which have to do with the

nature of the media used to develop and sustain telementoring relationships, and some of which have to do with the organizational and developmental distances that telementoring relationships span.

Currently, most telementoring occurs via electronic mail — an asynchronous (time-delayed) and primarily text-based medium. Because e-mail lacks the full spectrum of visual and auditory cues that people depend upon (often unconsciously) in face-to-face conversation, e-mail mentoring requires different interaction strategies that face-to-face mentoring or tutoring does to create maximal educational benefit (Harris et al., 1997). For example, more frequent and more explicit purpose-setting, progress-reporting, and problem-solving communications may be necessary on-line than in face-to-face interaction (Kimball & Eunice, 1999, November).

Other differences between curriculum-based telementoring and traditional face-to-face mentoring have little to do with the nature of the Internet or the particular communication tools that students and mentors use. Rather, they stem from the developmental and organizational distance between telementors and their mentees. One scholar of human relationships, Duck (1994, p. 57), has described relationships as “unfinished business” , and this description provides an important insight into the differences between mentoring relationships in the on-line and face-to-face contexts. At their core, these two types of relationships are about finishing business of different kinds. To understand this fully, it is necessary to think about the specific contexts in which mentoring has traditionally occurred, and what purposes these relationships serve for their participants in those contexts.

One of the most frequently cited pieces of research on mentoring is Kram’s study of middle managers and their near subordinates in the offices of a public utility company (Kram, 1985). As Kram details in her book, workplace mentoring relationships like these are largely intended to facilitate the mentees’ transit through the organizational context that surrounds them (and their mentors). If all goes well, the relationship leads to the full realization of the mentees’ career potential, and the recognition of this potential in through different assignments, raises, promotions, or other changes in job role.

In contrast, the K-12 telementoring relationships that we discuss here take place between people (students and adults) who work and learn in two *different* settings. Whether the mentor works in a university, a corporation, a nonprofit organization or a branch of government, it is a very different place from a K-12 school. Furthermore, the ideal result of telementoring relationships is not that students take jobs in the mentor’s organization and work their way up the career ladder, but that they accomplish rigorous academic work that stretches and develops their capabilities. We may also hope that students develop a richer understanding of what mature practice in the mentor's field looks like, but for curriculum-based telementoring this is usually a secondary goal.

The simple fact that telementors and their mentees do not share a single organizational context has large implications. Though all of our mentors have were once students themselves, they and their mentees sometimes struggle to understand where their new learning partners are "coming from" and

how they can best coordinate their work in light of this. For example, because most telementors have easy and frequent access to telecomputing tools throughout their work day, they are accustomed to having rapid multi-turn on-line conversations with colleagues throughout the day. K-12 students and teachers have much less frequent and less convenient access to telecommunications facilities, so they are liable to frustrate mentors' expectations of quick turnaround. For their part, students may fail to understand why their mentors cannot drop everything to respond to a query made hours before a deadline, the way a classroom teacher often can. These are two manifestations of the organizational distance that must be bridged for telementoring relationships to succeed.

On the positive side, mentors and mentees not sharing a workplace can also have advantages. One traditional concern with workplace mentoring relationships is that the mentor (who is generally a more senior person) might take advantage of his or her lower-status mentees. A mentee may, for example, feel compelled to take on work he or she should not, in the hope of building up goodwill with a mentor. This is particularly a concern in mixed-gender mentoring relationships (Kram, 1985). Even if there is no abuse and no temptation for it, concern about the appearance of impropriety can complicate or stifle the development of a mentoring relationship. In telementoring relationships, this potential complication is much reduced, if not eliminated.

Our general point is that building and maintaining telementoring relationships is a new and challenging task for students and adult volunteers, even if they have experience with face-to-face mentoring. In keeping with the developmental nature of mentoring relationships, students and their mentors must build understandings of their respective roles through direct experience. In the next sections, we discuss the nature of this process and how it can be supported.

Growing into the roles and norms of telementoring

In telementoring as in other forms of social engagement, people need to learn roles and scripts in order to play their parts well (Schank, 1977). As Harris has explained, this is more challenging than one might suspect in the context of telementoring (Harris, O'Bryan & Rotenberg, 1996). Above, we discussed the challenges that organizational distance between mentors and mentees can present. Another, more important challenge stems from the simple fact that mentors and mentees begin developing their understandings of telementoring from very different points. Some insight into these differences is provided in recent research conducted by O'Neill in conjunction with Marlene Scardamalia and the Knowledge-Building team at the Ontario Institute for Studies in Education.

In design experiments conducted in two Toronto-area high schools between 1997 and 1999, O'Neill and Scardamalia orchestrated 5-week telementoring relationships for 112 students of high school age, who were enrolled in general science and biology courses from grades 9 to 11. Their work with their volunteer telementors took place as part of a 10-week "Independent Study Unit" — a mandated part of the curriculum for these courses in which students traditionally write library research essays on their own time. At the end of the research unit, both the students and their mentors completed a brief survey that asked them to reflect on their telementoring relationships in a number of ways. Here we will consider just one of the items on the survey, which was designed to

reveal participants' desires to give and receive particular kinds of advice and guidance. In the students' version of the survey, respondents were asked to rate the importance of 10 different mentoring "functions" (types of advice, guidance or help) that a mentor could have performed for them in the course of their relationship. These Likert-type ratings were solicited under a question titled, "what would your mentor ideally have done?"

The 10 mentoring functions listed were:

- Helped me come up with a question/idea to investigate
- Asked me questions to help me think about my research
- Answered questions I had about scientific ideas
- Gave me background information on my topic
- Gave me locations on the Internet where I could find resources to answer my question
- Helped me to understand material I was reading about my topic
- Suggested challenging things for me to do that would improve my project
- Reviewed my work as I went along and helped me keep on track
- Gave me the names and addresses of other people to contact about my project
- Helped me to meet project deadlines that I couldn't have met otherwise
- Suggested specific strategies that would help me get my work done
- Suggested books/magazines/scientific journals that I should read

A similar set of prompts was used in surveys administered to 24 volunteer telementors. In the mentors' version of the survey, the same 10 mentoring functions were presented for rating under the following question:

> The following questions are about the types of mentoring activities that you would most like to undertake in the future. For each type of advice, guidance or assistance listed below, choose a number between 1 and 5 to indicate how much you would enjoy offering it to students. (1=not at all, 5=very much)

A factor analysis was performed on students' ratings of the desirability of the 10 inquiry telementoring functions, revealing that for them, they fell into two natural kinds (see Table 1). Below, we detail these factors and consider what measures derived from them can tell us about the distance between students' and mentors' perspectives on the mentor role.

The students' perspective on good mentoring

As Table 1 shows, four of the 10 functions loaded on students' Factor 1: background information, pointers to Internet resources, references to reading materials, and ideas about viable project topics or questions. Since each of these functions corresponds to a serious challenge that students face in the beginning phases of an open-ended inquiry (Polman, 2000) , O'Neill & Scardamalia labeled this factor "inquiry jumpstart".

Table 1: Factors underlying students' ratings of the desirability of 10 telementoring functions.

Factor 1 (Inquiry Jumpstart)		**Factor 2 (Prodding Partner)**	
Pointers to Internet resources	.83	Offer challenges	.81
Background information	.73	Ask questions	.78
Readings	.68	Review work	.73
Help shape project idea/question	.61	Help interpret data and learning resources	.67
		Suggest strategies	.54
		Explain scientific ideas	.52

While it is important that students have what they need to get started on a challenging investigation, it is equally important that they finish it. With this in mind, we consider the sharp contrast between the Jumpstart functions, as a set, and the functions loading on Factor 2. While the Jumpstart functions collectively do not imply any ongoing relationship or accountability between students and their mentors, the functions loading on Factor 2 do. By asking questions, reviewing students' work, and offering ideas about challenging things that students can do to learn more, a mentor remains continuously involved in students' learning. For this reason, we labeled Factor 2 "prodding partner".

As a set, the Prodding Partner functions are more clearly consistent with the reciprocal nature of the classic mentoring relationship. Thus, while many students might begin their experience of telementoring with relatively strong desire for Jumpstart functions, we would hope that with experience, their appreciation of and desire for the Prodding Partner functions would increase. In fact, it was shown in recent research that students' desire for the Jumpstart or Prodding Partner functions varies reliably with their exposure to diverse models of mentoring relationships (O'Neill & Scardamalia, 2000). These findings will be discussed in a later section.

Mentors' perspectives on the mentor role

What is more interesting than students' levels of desire for either the Jumpstart or the Prodding Partner functions is how they differ from mentors' desires to *provide* the same functions. On the basis of the factor analysis described above, two "role scales" were constructed to reflect a student desire to receive or a mentors' desire to provide mentoring functions of the "inquiry jumpstart" or "prodding partner" varieties. The calculation of an individual's score on each scale is quite simple. It is the sum of the respondent's desirability ratings for the functions loading on the corresponding factor. Scores are then normalized on a scale from 1 to 10.

It is encouraging to note that students' reported desires for the Inquiry Jumpstart functions do not differ significantly from mentors' desires to provide them. In this respect then, the mentors' and students' conceptions of good inquiry telementoring seem well coordinated. On the other hand, a Mann-Whitney U test indicated that mentors' desires to *provide* the Prodding Partner functions were significantly higher than the students' desires to *receive* them ($p \leq .01$). (See Figure 1.)

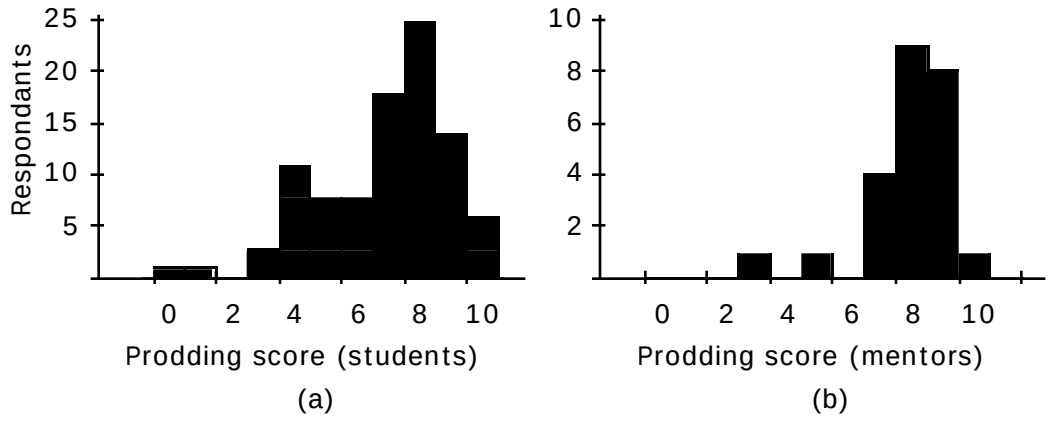

Figure 1: Students' desires to receive Prodding Partner functions (a), versus mentors' desires to provide them (b)

Further analysis based on these factors will be presented in a later section. On their own, however, students' and mentors' differential ratings of the Prodding Partner functions sheds some light on the gap to be bridged between students' and mentors' conceptions of good mentoring. Simply put, the 24 mentors we sampled appeared to have higher ambitions to shape the intellectual direction of students' work than the students themselves honored. This gap in expectations is of concern for reasons suggested by the quotation we used to open this paper. To the extent that mentors and students diverge in their ideas about what inquiry telementors *should* do, it will be difficult for them to effectively coordinate joint thought and action.

In the next section, we will discuss three strategies that we have used to bridge this distance, by supporting participants' growth into more mature conceptions of the mentor role.

Supporting mentors' and mentees' growth: Why "training" is not enough

Wherever we present our work, we can rely on someone in the audience asking how our mentors and students are "trained" to play their parts. While this question is understandable, we think training is an unproductive concept to apply to telementoring. Usually, training is thought of as an experience that prevents people from making mistakes (as "driver training" prevents you from getting into an accident); but mistakes made in the context of mentoring and being mentored are not best thought of as preventable disasters. To the extent that the potential for making mistakes is taken out of telementoring, a significant amount of learning potential may also be removed.

Setting this philosophical objection aside for the moment, there are is also a practical argument against the idea of "training" mentors and mentees. Simply put, it is unclear what one would train mentors and students to do. The roles and scripts for telementoring vary widely, depending on the nature of curriculum it serves, the nature of the media used, and other factors. Also, because every mentee has a unique personal history and set of resources to draw upon when carrying out

classroom inquiry, each will offer different challenges. Still, life would be relatively easy for telementors if this were all they needed to be concerned with. Finally, the particular research ideas mentees are working with, their selection of research partners, and their access to the resources necessary to carry an investigation forward are often as important to the success of a telementoring relationship as the people involved.

Together, these factors create such variety in the lived experience of mentors and mentees that it is not possible to offer simple prescriptions for mentors' and mentees' behaviour that will keep them from making "mistakes", and abstract "rules of thumb" that *seem* to cover a range of contingencies are often too decontextualized to transfer well. (It is one thing for a student to read and understand a set of guidelines that recommends "being respectful" of their mentors, but it is quite another to continuously analyze social situations and appreciate how to apply this rule.)

Because we believe that up-front "training" of mentors and mentees is prone to failure, we prefer to support our participants' growth into the roles and norms of telementoring through other means. Below, we discuss three strategies that we have used over the past several years: iterative cycles of telementoring, direct facilitation, and opportunistic access to models.

Iterative cycles of telementoring

One general approach to helping both students and mentors grow into their roles is simply to give them additional authentic practice. This was the approach taken by O'Neill and Wagner in their work with the CoVis project (O'Neill et al., 1996). In Wagner's classroom, students carried out three lengthy science projects over the course of the school year, most often under the guidance of a different volunteer telementor each time. While this design was primarily intended to help students refine their sense of how to carry out an empirical investigation (by trying, stumbling, and trying again), it also gave students and mentors the opportunity to try their respective roles on for size, make mistakes, and apply the lessons they learned to a new relationship. This type of "failure-driven learning" has been defended strenuously on theoretical grounds by Schank (1982), among others.

There are two clear limitations to this strategy, however. The first and most obvious is that in many settings, teachers may not be able to afford to invest curriculum time in several long telementored curriculum units for the sole purpose of having students learn about mentoring. Like Wagner, they would have to believe in the value of iteration for achieving other, more focal curriculum goals. A second, less obvious problem with the iteration strategy has to do with mentors' and students' motivation. Relying almost exclusively on trial-and-error learning may result in a large number of "failed" relationships, which may lead in turn to significant frustration among students, and significant attrition of volunteers. Both of these potential complications work against the sustainability of telementoring programs.

Direct facilitation

For a number of years, Harris and her collaborators have supported students' and mentors growth into their roles through an approach they call "direct facilitation". In this approach, medium-specific strategies for developing and sustaining on-line mentoring relationships are suggested in real time by a third party who closely follows and participates in the telementoring dialogue. Harris and her collaborators have found that the people best equipped to play the facilitator role are those who have experience in both Internet-based communication and education. This combination of experience enables them to help project participants build mutually accessible bridges between their differing workplaces' ways (Harris et al., 1997). Facilitators "act as 'playground monitors' or gentle guides, while participants 'play in the sandbox,' developing the norms and rules [of telementoring] as they go" (Palloff & Pratt, 1999).

Though the nature of the facilitators responsibilities is dependent largely upon the ways in which particular telementoring projects are structured, facilitators help members of telementoring teams to:

- Set up and test communications facilities (accounts, filters, etc.).
- Introduce themselves, getting to know each other personally and professionally.
- Set realistic project goals and expectations.
- Get answers to procedural questions.
- Adjust goals and expectations according to project developments.
- Keep communication flowing throughout the project period.
- Identify, address and resolve miscommunications.
- Structure and participate in different kinds of on-line activities.
- Evaluate individual and group contributions to learning/teaching.

Telementoring facilitators must be careful to assist and suggest, rather than direct. This is more easily said than done, especially in the case of an electronic team that is not communicating regularly or effectively. It is essential that team members assume responsibility for the success of the exchange. As one seasoned facilitator explained to some less experienced peers,

> You have now set the stage for the exchanges to begin and, at this point, it is up to the participants to "take charge." Let them know that you are available to answer any questions that they have and will be happy to assist them in any way you can, then take a step back and see what happens. (Wadbrook, 1999)

In many cases, this means that the facilitator must "translate" for and advise telementoring team participants, using only her accumulated experience with communicating on-line, and her knowledge of the differences between K-12 schools and other contexts. For example, Figg (1997) analyzed a series of misunderstandings between a telementor and the teacher and students with whom she agreed to work:

> As she communicates with the students regarding health issues, [the mentor] constantly points out that many issues in health require a medical doctor. The teachers and lab teachers have "interpreted" this personality as not making an effort to communicate with the

> students and are disgruntled with the progress of the project, which is not how I interpret her on-line personality at all. …I have spent much time communicating with [the mentor] to get her to personalize her responses more and open up more with the students. At the same time, neither the lab teacher nor the classroom teacher have made efforts to communicate with [the mentor] and often the students ask the same questions of [the mentor] over and over, so there doesn't seem to be any "teacher facilitation" at [the classroom level]. And, I have spent much time talking with the classroom teacher regarding how she could help the students form better questions for [the mentor]. In addition, I have spent time with the students suggesting ways to improve their questioning techniques. (Figg, 1997)

This facilitator's description illustrates the sensitive work that able facilitators can do to overcome misunderstandings between mentors and their mentees, as they grow into their roles.

As with the iteration strategy, facilitation has some built-in limitations. The most important of these is cost. Because able facilitators bring both technological and pedagogical skills to their work, and because they must be very reliable, they normally command a salary. This cost alone can significantly limit the capacity of a program to reach large numbers of students. And where cost is not an obstacle, the supply of qualified facilitators may be. Because she works in a college of Education, Harris has been able to locate able facilitators with relative ease. Other types of host organizations might find this a greater challenge.

Despite these limitations and costs, there is no good reason for the coordinators of telementoring programs *not* to make use of facilitators if they can find them and can afford them.

Opportunistic access to models

A third strategy for supporting students' and mentors' growth into their roles, recently developed by O'Neill & Scardamalia (2000), appears to be less time-intensive than iteration and less resource-intensive than facilitation. As part of research mentioned earlier, O'Neill & Scardamalia orchestrated telementoring relationships for 112 high school students in a shared electronic workspace called Knowledge Forum®, instead of private e-mail. One unique consequence of this arrangement is that it allowed students and their mentors to observe and learn from not only *their own* telementoring relationships, but also *one anothers'* experiences when they felt motivated to do so. Because these telementoring dialogues involved familiar circumstances and personalities, lessons drawn from successful relationships could presumably be transferred more easily than they would be from pre-prepared cases.

The arrangement for model-seeking worked roughly as follows. After declaring their research interests to their teachers, students were organized into thematic "working groups" of varying sizes: from a single student to 10 or more. As in other telementoring programs, "matches" were then made between each of these working groups and a volunteer mentor with related expertise, who oversaw their research. Within the public Knowledge Forum® workspace that mentors and students shared, "views" (compartments) were set up to help the various research groups organize their efforts.

However these were more like movable curtains than walls. While each student and mentor had a "home" view in which to place their research notes and communicate with others, these views were open for everyone to read and write in.

O'Neill and Scardamalia found that students spontaneously took advantage of the affordances of the Knowledge Forum® software and the telementoring participation structure to seek models for their own behaviour — despite not having been told to, or awarded grades for doing so do so. This "opportunistic model-seeking", as we call it, allowed students to emulate the best practices they observed among their peers and peers' mentors. As one student explained in an interview:

> Yeah that's what I found [Knowledge Forum™] really useful for...not just in my [part of the database], but when I looked around...it was nice to see where people were, so I knew if I was ahead or if I was, like, behind a little bit. So...it was nice to see...what other people were doing.

Students didn't merely *enjoy* the freedom to observe their peers' mentor relationships, though. Correlational analysis of data from student surveys and records of their reading behavior in the Knowledge Forum® database showed that students who opportunistically observed the mentor relationships of their classmates became "choosier" about what they wanted from telementoring. In particular, students who read extensively in the Knowledge Forum® database were likely to desire the kinds of advice and guidance associated with a prodding partner (e.g. asking useful questions, reviewing work), rather than an inquiry jumpstart, as we discussed in an earlier section.

These findings suggest that making telementoring dialogues public can help students to develop more mature understandings of the mentor role. Additional data will be needed to quantify the benefits that opportunistic access to models has for telementors, but qualitative results so far are encouraging. Take for example this statement from a volunteer about how examining other mentors' advice-giving strategies helped her order to improve upon and validate her own:

> ...I started, I guess, peeking in on some of the other discussions to see what level of assistance was going on, and how harsh you should be about certain things. Because you want to be encouraging, but you also want to say, you know, you're really out of line there, way off in left field. And maybe you should think about this (laughs). Where are you going?

Like iteration and facilitation, the strategy of providing opportunistic access to models has associated costs. One of these is a certain amount of social friction. In classrooms where private e-mail telementoring takes place, students can and do swap stories about whose mentors have offered the most generous support; but direct comparisons between mentors are difficult. Public telementoring dialogues, in contrast, afford not only the constructive model-seeking behavior we described above, but less constructive direct comparisons of mentor performance. As one student explained:

> Student F: Yeah, [I read some other views] out of curiosity, to see how their mentors were doing, how many of them had written back, checked out their final papers.

> Interviewer: OK. What did you get out of that?
>
> Student F: Well some of them, the mentors were never there. My friend? [His mentor was] never there. I felt more fortunate, because mine was always there and she helped me a lot more.

Naturally, students on the "losing" end of such comparisons did not feel so fortunate, and this created some discontent. However, the publicity of the mentoring dialogues actually appeared to soften this discontent in an indirect way. It is common for e-mail mentees to trade stories about the help they got with their work, but uncommon for them to talk in any detail about the dialogue leading up to this support. Public telementoring allows students to conveniently see not only the advice and assistance that other mentors offered their mentees, but also how much effort mentees themselves must invest to make their mentors' contributions possible. In particular, students can see how hard their peers work to provide mentors with high "visibility" — clear and thorough descriptions of the work they have been doing, where it is headed, and what challenges it presents (O'Neill & Gomez, 1998, November).

Whither strategies for growth?

It is important to note that iteration, facilitation and opportunistic access to models are not mutually exclusive strategies for supporting students' and mentors' growth. Under the right conditions all three could be implemented together. Above, we offered a sketch of the benefits and costs associated with each strategy, but ultimately what is needed to support the design of more effective telementoring programs is a cost/benefit analysis of *combinations* of these strategies and their benefits for each of the major role groups involved (students, mentors and teachers). Ideally, for instance, program designers would know to what extent opportunistic access to close models would strengthen the benefits that facilitation or iteration would provide for each role group. As yet, however, no research has explored the value that each of the strategies we discussed above can add to the others. There is clear potential for quasi-experimental research into these issues.

Fulfilling the developmental needs of telementors at scale

Above we examined telementoring through two conceptual lenses. First we considered it as a new mode of voluntarism, then as a new venue for human development. In the remainder of this paper, we will bring these two themes together and consider what they can tell us about both the ultimate potential of telementoring, and how it can be reached.

After reading about our experiences with hundreds of volunteer telementors and their mentees, we are often asked how practical the idea of telementoring might be at a larger scale. If it has such potential to support ambitious constructivist pedagogy, it would ideally be brought into schools and districts nationwide. But could it be?

We believe that telementoring could play a useful role in strengthening reform efforts throughout the U.S. and Canada; but only if the organizers of telementoring programs dedicate themselves as thoroughly to serving the developmental needs of volunteer *mentors* as they have to serving the needs of K-12 students. As we will see below, the potential volunteer pool for telementoring is large; but not so large that organizers can afford steady attrition from the pool. If telementoring programs are to grow *and* be sustained, it will be necessary to understand and serve the developmental needs of volunteer mentors well.

Volunteers' motivations and needs

Most of our readers will appreciate how important a sufficient number of qualified volunteers is for a successful implementation of telementoring; but they may know little about the prevalence of voluntarism in our society or the developmental needs which drive it. Thankfully, voluntarism has been studied extensively by the US Census Bureau and other agencies for many years.

Back in 1987, survey-based studies of volunteering were conducted in both the United States and Canada using sample sizes of and 60,000 and 70,000 people respectively (Hayghe, 1991, February; Ross & Schillington, 1988, November). The American study, based on data from the Census Bureau's Current Population Survey, showed that about 22 percent of women and 19 percent of men over the age of 15 did some work as unpaid volunteers during 1987. In Canada, almost 30 percent of women and almost 24 percent of men contributed time to volunteering of one form or another during the same period. Taken together, this volunteer labor force amounted to roughly 33 million people (3 million in Canada, 30 million in the U.S.), most of whom contributed between 3 and 5 hours per week to their chosen causes — considerably more than the average commitment required of telementors in the work discussed here.

While a lot has changed since 1987, adults' proclivity to volunteer apparently has not. A recent large-sample survey conducted by Statistics Canada found that volunteer participation rates in many age brackets had actually increased in that country over the past 10 years. This study also reinforced a consistent finding in broad-based surveys on the volunteer labor force, that the likelihood a person will volunteer increases with both level of education and household income (Hall et al., 1998; Hayghe, 1991, February). Clearly these are positive findings for telementoring enthusiasts. In fact, when one considers recent figures for educational attainment, voluntarism and home Internet access, the potential number of volunteer telementors looks quite high indeed (see Table 2).

Table 2: Likely limit of willing and qualified telementors

Country	Number of people with bachelors' degrees[2]	Percentage of Graduates giving time to teaching or coaching[3]	Percentage of graduates with Net access at home[4]	Likely limit of willing/ qualified telementors
Canada	3,000,695	27	46.7	378,357
U.S.	30,090,000	17	46.6	2,383,729
Totals	33,090,695			2,762,086

But let's not count our eggs before they're hatched. If program designers are serious about making the most of this potential, they must ask themselves why educated adults would choose to serve as telementors, rather than taking part in other worthwhile civic activities. This has certainly been more than an idle curiosity for the teachers and students who have been involved in our work over the years, and for good reason. Ultimately, for students and teachers to understand and relate to their new on-line collaborators, they must have a working knowledge of what motivates them.

In this connection, it will be useful to reflect on another of the findings in the Statistics Canada study. Among the questions included in that survey was a multiple-choice question about respondents' motives for volunteering. Of the seven non-exclusive response categories on the survey, the one most frequently selected was "believe in cause supported by the organization" (96%). This was followed closely by "to use skills and experience' (78%) and "to explore one's own strengths" (54%). Thus, while nearly all volunteers donate their time to causes they believe in, they do not do so merely to further those causes. To a great degree, volunteers also wish to explore and develop new personal strengths, or exercise skills and experience for which they presumably do not find use in their paid work.

The findings of the Statistics Canada report nicely parallel those of a qualitative study recently conducted by Abeygunawardena and O'Neill on a set of 13 audio taped interviews with volunteer telementors (Abeygunawardena & O'Neill, 2000, April). Without exception (and without prompting) each of these interviewees mentioned that part of their motivation to serve as telementors grew from their desire to support young students in undertaking challenging research projects in science. For these volunteers as for volunteers more generally, telementoring provided an opportunity to promote a cause they believed in.

As with the Statistics Canada findings, however, this motivation was not pure and simple. A smaller but significant proportion of the interviewees (7/13) also expressed satisfaction with the opportunities that telementoring had given them to realize their own competence as researchers and teachers. One example comes from a volunteer's experience with a team of students studying the

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[2] Figures from Day, J. and Curry, A. (1998) and Statistics Canada (2000).
[3] From Hayghe (1991) and Hall, M. et al. (1998).
[4] From Dickinson, P. and Sciadas, G. (1997) and Newburger, E.C. (1999).

woolly mammoth. This mentor felt that given the limited resources of their library, the students would be better off broadening their agenda:

> I suggested that rather than just doing “the Woolly Mammoth”, maybe [they should do] something around...mammalian and vertebrate ecology of large animals, in that area, during that time, and how they interacted. And they seemed to really bite on that. That I felt kind of rewarding. It felt to me that this was something that perhaps they hadn’t thought about, or that this was something that pricked their imagination. Maybe that...motivated them to really get into it. ...They wrote me back and...I guess they discussed these things, and thought it was a good idea.

In a similar way, another volunteer described the satisfaction he felt at having located some hard-to-find sources for his mentees:

> What was particularly fun for me was to poke around the web and actually find this data [my mentees needed]. I looked quite a few places, I even called the Environmental Protection Agency and things like that. Ultimately I just found exactly what they needed on the web, [and] when I sent that they were quite elated. That was nice feedback.

In the end, it should not be surprising that some of our most satisfied volunteers are the ones who had found in telementoring a way to support the growth of others while continuing their own learning in some way. As another of O'Neill's volunteers, a Ph.D. student in Physics said of his work with a group of students studying black holes:

> I really enjoyed it, and for me it was great. I'd be sitting down, coding all day, writing [computer] programs, and I'd be able to take, you know, a half hour, an hour break every couple of days to answer this e-mail and look up something that I wanted to learn about. ...It was, you know, great! [When] I'm really sick of my work, I can go...spend a half an hour learning about something else I enjoy.

Summary and Conclusions

It has become a truism that the Internet will change the way our cultural institutions work (Dyson, 1998). Not all of this change will be for the better, certainly; but we believe that inquiry telementoring will be. Years of experience in schools and classrooms in both the U.S. and Canada have shown the potential of this innovation to support valuable new learning experiences for a host of people whose learning needs could be better served. Among their ranks are millions of students in K-12 classrooms who rarely have the opportunity to pursue challenging, long-term inquiry, because their teachers lack the confidence or expertise to attempt it alone. The experience of telementoring could also benefit millions of knowledgeable adults, who would like to volunteer their time to work with youth, but whose schedules cannot accommodate regular visits to schools.

In the previous sections, we explored some of the synergies between the learning needs of children and adults that could be more fully realized in a computer-mediated "knowledge society"(O'Neill &

Scardamalia, 2000; Scardamalia & Bereiter, 1996). For this to occur however, the organizational and developmental distances between telementors and their young mentees will need to be better understood, and more effectively bridged by telementoring programs and technologies. Because the ability to play the role of a good telementor or mentee is not fully developed over the course of days or weeks, socially sustainable telementoring programs must have mature strategies for supporting mentors' and mentees' growth into their roles over an extended period of time.

This agenda is key to the development of socially sustainable telementoring programs. Even with the recent explosion in personal access to the Internet, the number of potential volunteer telementors is finite and exhaustible; and like undergraduate tutors (Dickinson, 1999), telementors are unlikely to continue serving in this role for a period of years simply because it is a "good thing to do". They have their own learning agendas, which current K-12 telementoring programs do not take as seriously as they need to. Here we discussed three strategies for supporting telementors' and mentees' growth, which we believe could be fruitfully combined. These strategies provide a fertile ground for experimentation, and reflect a fundamental truth about telementoring programs: that their development is continuously dependent not only on the cleverness of their organizers, the materials they develop, and the sophistication of the software they design, but also on the cultural capital that participants bring to them and develop through them.

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