THE TELEMENTOR'S GUIDEBOOK

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a field guide to supporting student inquiry on-line

Office of Learning Technologies
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Origins and Acknowledgments

The work discussed in this document took place in two phases. The first phase began at Northwestern University in Evanston, Illinois as part of a large science education reform project called Learning Through Collaborative Visualization (CoVis). This project, which was created by Drs. Roy Pea and Louis Gomez with funding from the National Science Foundation (Grant MDR-9253462) and the Illinois State Department of Education, provided the original inspiration for O'Neill's work with two innovative teachers: Rory Wagner and Judith Lachance-Whitcomb. Their work with O'Neill was the first focused exploration of the potential for e-mail based telementoring to support project pedagogy in middle and high school science classrooms.

After completing his doctorate, O'Neill began the second phase of this work, in collaboration with the CSILE/Knowledge-Building team at the University of Toronto. Continuing to focus on supporting ambitious inquiry in science classrooms, he and Drs. Marlene Scardamalia and Carl Bereiter began to develop models of telementoring that were suited to students' work in richly-structured asynchronous group workspaces, such as Knowledge Forum®. This phase of the research was generously supported by the James S. McDonnell Foundation and the Natural Sciences and Engineering Research Council of Canada.

It was at the beginning of this second phase of the telementoring research that O'Neill and Scardamalia became increasingly aware of the need to support adult volunteers in taking full advantage of the learning opportunities that telementoring presents for them. To that end, an application was made to the Office of Learning Technologies, Human Resources Development Canada, for funding to explore these issues. That support made possible the document you have before you.

Aside from the collaborators and funders mentioned above, special thanks are due to five hard-working Toronto-area teachers without whose support and comradeship the second phase of this research would not have been possible. Unfortunately, school board regulations prevent us from mentioning their names here; but they know who they are. We are grateful to them for their hard work and thoughtful contributions, as we are to the many generous volunteer telementors and students who shared their experiences with us. We hope this work does you justice.

Foreword

What is Telementoring?

The idea of telementoring is a simple one: using telecommunications technology (including e-mail, conferencing systems, or telephones) to develop and sustain mentoring relationships where face-to-face ones would be impractical. In the field of education, telementoring often involves linking students up with knowledgeable adult volunteers who have an interest in fostering their development. This sort of arrangement allows the participants to take part in intellectual partnerships that would not otherwise take place.

Telementoring is a relatively young area of research and practice in education, but over the past several years a number of multi-year projects and initiatives have demonstrated its usefulness as a way to enrich the career guidance and academic support that students receive in school (Bennett, Hupert, Tsikalas & Meade, 1997; Harris & Jones, 1999; Neils, 1997; O'Neill & Gomez, 1998, November; O'Neill, Wagner & Gomez, 1996). Expertise in a subject area is an important asset for telementors, however it has become increasingly obvious that this is not enough. Research has made it clear that if telementoring is to thrive and grow as a tool for educational improvement and lifelong learning, telementoring programs must provide their volunteers with opportunities to learn and grow from their mentoring experiences. This is one of the reasons we have developed this guidebook.

Telementoring for what?

Like other ways in which community volunteers can get involved in education, telementoring relationships can serve a wide range of purposes. Volunteer mentors might, for example, provide students with career guidance, academic advice, or direction on specific problems and tasks they encounter at school. We believe there is value in all of these objectives. The work discussed here, however, has focused primarily on telementoring to support students and their teachers in carrying out ambitious, long-term investigations during regular curriculum time. We will explain the thinking behind this choice in later sections.

One thing that attracts corporations, universities, museums, and community organizations to telementoring is that unlike many other types of community outreach, it does not demand large monetary resources. Just about anyone with access to e-mail, and who has experience that would be valuable to students, has

the potential to become a volunteer telementor. And, as we will discuss in the following Chapters, many have found this to be a fun and rewarding experience.

Why this guidebook?

Early work on telementoring has taught us quite a bit about how on-line mentoring relationships differ from face-to-face ones, as well as how they differ from more traditional, and better-studied helping relationships like tutoring. Research has also taught us important lessons about what it takes for on-line mentoring relationships to succeed in ways that satisfy the needs and expectations of students, teachers, and volunteer mentors alike.

Most of the published work on telementoring has focused on the benefits this activity can have for students. But as mentoring researchers (e.g. Kram, 1985) have pointed out over the years, the essence of mentoring is that it is a *reciprocal* relationship. This is a fancy way of saying that it must be a two-way street with regard to learning. If a mentoring relationship is working well, both the mentor and the mentee will learn and draw rewards from the effort they invest.

The purpose of this guidebook is to distill in a few pages, and in a practical format, what research and practice in telementoring have taught us about what volunteer telementors can gain from telementoring, and how. In the next few chapters, we will explain:

- What telementoring is and how it happens
- What you and your organization can contribute to education through telementoring
- The types of commitment required of telementors
- Challenges that telementors and their mentees typically face
- Strategies for overcoming these challenges
- Hints on making the most of your telementoring experience

We will explore these themes using interviews with volunteer telementors and students and transcripts of their correspondence. Some of this data will be presented in the form of true stories about the mentors and mentees we've worked with, their experiences, and what these experiences reveal about successful telementoring relationships.

How to use this guidebook

Our hope is that this guidebook will be useful to companies, universities, and community organizations in two ways:

- **For organizations:** This guidebook should help organizations to figure out whether they are interested in and suited to provide telementoring services as a routine form of educational outreach and staff development.

- **For volunteer telementors:** This guidebook has been designed to prepare you for the challenges that new mentors commonly face in telementoring relationships. You may also find it useful as a desk reference to consult when you are composing your responses to students. Either way, we hope it will help you to begin, or continue your development as an effective telementor.

Chapter 1: Introduction

Possible roles for "experts" in Education

For many years, teachers have invited other adults, including parents and community volunteers, into their classrooms from time to time. Often, the purposes of these visits are for adults to share their unique knowledge and experiences with students, in one way or another. But not all expert visits are alike. In order to understand telementoring, what is fundamentally new about it, and the particular ways in which it is challenging and worthwhile for telementors, it is important to set it apart from some of the ways that adult volunteers have traditionally been involved in schooling. These include "ask-an expert" programs, one time judging events like science fairs, one-on-one tutoring, and non-academic mentoring. There are important differences between each of these activities and telementoring, which we describe below.

Ask-an-expert

One traditional way for adults to become involved in education is through one-time 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. However, they have some important built-in limitations, as one of the teachers involved in our work 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. You can find a variety of these "Ask-a" services on the Internet today: Ask-a-Geologist, Ask-a-Librarian, Ask-an-Astronomer, Ask-a-

Linguist, 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 carrying out more challenging open-ended investigations. We believe that students should be doing more of these challenging assignments, because it is only in this way that they learn to manage their own learning.

This brings us to another limitation of Ask-a services. By their nature, they do not give students the opportunity to develop their ideas with a more knowledgeable adult over time. Ask-a services 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 adult is essentially designed out — and so is the satisfaction that the adult can gain from watching his or her ideas influence students' development 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. Again, this can be quite worthwhile, but also can be improved upon.

In both science fairs and public speaking contests, students prepare a complex product or performance over a relatively long period of time. (Though many adults will remember throwing their science projects together over a weekend, they will also remember that this is many more hours than they worked in school without *some* kind of guidance or supervision from an adult.) During the time that they are preparing their projects and presentations, students might have some input and assistance from peers, siblings, or parents, but they are largely on their own. Finally, after all that 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 other students 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 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. For example, if you are doing very well in many of your subjects at school, but have a particularly difficult time with Calculus, Biology, or English, a tutor may be just the thing for you.

Tutoring is often confused with mentoring because unlike the 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 the expert's 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 largely in control of which problems the student works on, and when. There is little discussion about what the students are really interested in.

As many will know, tutoring and mentoring are not entirely exclusive. A mentor may, from time to time, assign specific learning tasks, as a tutor would, to help students solve the larger problems of understanding they encounter when they are working on ambitious investigations. But a mentor also attends to more global issues and concerns.

Mentoring

The idea of mentoring 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.

Mentoring is quite different from tutoring in that *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.

There is an important distinction between naturally-occurring mentoring relationships, which are rare, and formally-arranged mentoring relationships, which are more common. 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). 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.

Telementoring

Because of these difficulties, the last several years have seen growing interest in the idea of using the Internet to support mentoring relationships. Existing telementoring programs take a variety of forms, yet all share the approach of orchestrating supportive relationships between adult volunteers and K-12 students that stretch over weeks or months. These on-line relationships often serve subtly different purposes from traditional mentoring, and have unique needs for support and organization.

One of the main appeals of using Internet media such as e-mail or conferencing tools to develop and sustain mentoring relationships is to reduce the travel required for volunteers to maintain an active involvement in students' work. This allows adults outside the school to maintain lengthier and more intellectually involved relationships with students than would otherwise be possible. As Dan, a Ph.D. student in Physics, said of his experience advising a group of three high school 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.

What telementoring brings to the classroom

The most compelling reason to orchestrate telementoring relationships for students is to take greater advantage of their unique personal interests. In many classrooms, the limits of a teacher's own time and expertise might make it necessary to confine their students' research to a narrow set of subjects. With the involvement of appropriate telementors, it becomes practical for 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. This added variety of students' work adds interest for both students and teachers.

As the stories included in this guidebook will illustrate, an important part of what a mentor does is facilitate students' best thinking by "problematizing" work which they might 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. Whitcomb, one of the teachers involved in O'Neill's early work (O'Neill, in press), once explained how the participation of mentors 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. 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.

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 investigations were 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 to 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 related to their grades on a traditional content test.

Finally, telementoring provides some unique opportunities to increase students' awareness of adult careers. While telementoring relationships gain focus from students' school work, they can also provide opportunities for students to encounter adult work in a way that makes it more meaningful to them. For example, one of O'Neill's collaborators, Wagner, explained that his most important motivation in arranging telementoring relationships for his students was:

> ...that the kids can see how scientists think, how they work. Not only get the information, because they're going to get that, because they could get that from anybody who's knowledgeable, but also the process of doing it.

Several examples of this type of guidance will appear in Chapter 2.

A sample telementoring relationship

A brief look at one telementoring relationship may help clarify the benefits we have been describing. While neither the best nor the worst relationship we have studied, this example briefly illustrates some of the key facets of telementoring, and how they are influenced by events in the classroom.

Rory 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 his students is to let them study deeply whatever most interests them within the scope of his course, from stars to 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.

In the final quarter of the 1995/96 school year, a team of two students in Wagner's class decided to do a research project on earthquakes. Wagner matched this team with a Geology graduate student whom 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.

[1] A pseudonym. Throughout this document, only two teachers (Wagner and Whitcomb) are referred to by their real names. They have given their consent to be identified.

(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 by Mandy's two mentees:

> 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.
>
> 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.

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.

Note in Mandy's response (below) that she shares Robert's relief, but stresses the importance of making good use of the additional time he has been given. She also requests a summary of the work he and Marilyn have done, so that she can continue to offer informed advice:

> 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 through 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

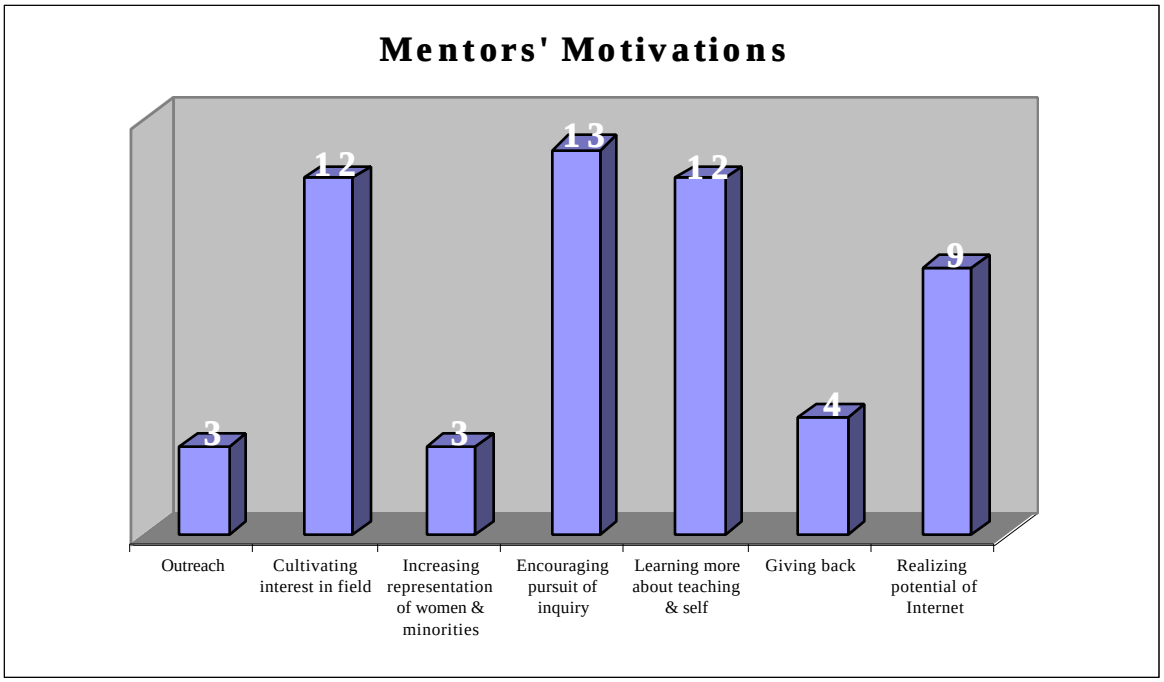
Three things are important to note about this message and the dialogue as a whole. First, this dialogue between Mandy and her mentees is driven by the project requirements and deadlines that the teacher has put in place. These both stimulate conversation and provide a common frame of reference in which 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 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 may miss school, or bicker, or fritter away time. The teacher is still responsible for mediating these factors and for 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.

Why be a telementor?

Now that you know a bit about what telementoring is, and how it differs from other ways that adult volunteers can get involved in K-12 education, you might find it useful to hear some of the reasons why others have chosen to invest their time in it. Over the past five years, we have enabled hundreds of volunteer scientists to mentor students via email or computer conferencing. They have offered advice and guidance to middle and high school students undertaking ambitious, long-term research that cultivates their abilities to define and pursue problems of understanding independently. In this section, we examine some of the reasons why our volunteers have chosen to dedicate their time to this endeavour. For the most part, we use their own words, drawn from hours of telephone and in-person interviews. Perhaps you will find echoes of your own thoughts in what you read.

The quotations below are drawn from interviews conducted with thirteen volunteer telementors. Each had completed at least one telementoring relationship at the time they were interviewed, though some had been serving as telementors for several years. After careful reading and re-reading of these interviews, each of which lasted from 30 to 150 minutes, we identified seven general themes in the volunteers' motives. These are shown in Figure 1, along with the number of volunteers who mentioned each one. We elaborate on each of the motivations below, using quotations from our volunteers. The names mentioned are all pseudonyms.



Doing outreach for your employer

One driving force in telementoring which will become increasingly important in the future is organizational outreach. Many corporations, research labs and government agencies conduct outreach activities as part of their day-to-day work — through contests, broadcasts, or increasingly, web-based events. Many of our volunteers may have been involved in events of this kind, but wanted a way to become more directly involved in students' intellectual development and in shaping their thinking about their future careers. Telementoring appealed to these professionals because it provided a convenient way to have this direct involvement. Most of our volunteers found that a few minutes each week was all they needed to provide adequate guidance to their mentees.

Cultivating interest in your field

Because our work to this point has all been in the realm of science, it should be no surprise that 12 of our 13 interviewees expressed a clear desire to cultivate interest in science among the young. As scientists themselves, they were passionate about the importance of promoting science at the high school level, and viewed telementoring as an opportunity to work directly with students. For example one of our telementors, Thompson, was motivated to volunteer by his own boredom with science in high school. As he explained:

> [Back then] I would just do my own thing, because getting into a discussion like this [with a mentor] just did not happen. There weren't people around that really could talk about it, so you just did your own thing, you didn't really explore your creativity. I think if you get a whole bunch of people that are really keen [together, it] validates your interest in science.

Another of our volunteers, Randy Roberts, picked up this theme in stressing the importance of having a community of interest to work with. As he said, "I get pretty turned on by people who want to know and do science. If I can contribute to that on any level or to any degree...to help a kid to really catch on fire about science, [I will]."

This encouragement is not a one-way street, either. Another of our volunteers, Thomas Davidson, reminded us that from time to time, even professionals need to have their interest in their work rekindled. Guiding his mentees through their own research gave him a new perspective on his work and refreshed his sense of its meaning. As he said:

> Just to be able to spread what I've spent five years of my life doing. To have somebody else interested in what I'm doing, and possibly a career. To lead them to something like I might do.... [It provides me an opportunity to] guide and focus a younger generation...helps me realize that what I'm doing is right.

In a similar way, many of our other volunteers were motivated to become telementors both to promote an interest in their chosen fields among youth, and to refresh and confirm their own interest in the careers that they have worked so hard to build.

Increasing the representation of women and minorities in your field

Our sample of thirteen volunteer telementors included four women, who had special motivations worth mention here. Three of these women saw telementoring as a direct way to help overcome the shortage of female role-models in their fields, and support young women in their pursuit of careers in science. One volunteer, Jodi Borden, was frank about the difficulty she faced in becoming a scientist without the support of a female mentor. She was eager to help fill that gap as a telementor. As she said:

> The other reason why I wanted to do this is that mentoring in my generation just didn't happen! If you were lucky, you glommed onto a Prof. at the university level as a mentor, but [there was] nothing before then. [For] women in science especially, there just was not that opportunity. So, if you can provide those sorts of role models early on, and they become consistent, that might be a neat element.

Encouraging the pursuit of challenging inquiry

All thirteen of our interviewees were motivated to become telementors because they knew how difficult it is for young students to undertake independent research projects. Yet, they felt it was important for them to do so, in preparation for their future pursuits. Telementoring was, for them, an opportunity to walk through an investigation with students and help save them unnecessary frustration. As Don Stark explained, "I know in my life, sometimes it's very difficult to really [figure out]...'well, what do I want to know?'"

As you will see in later sections of this guidebook, a telementor usually follows the course of students' inquiry for several weeks. In their initial exchanges with their mentors, students tend to look for suggestions or information on broad topic areas they might explore. Less often, they ask for advice on choosing between a number of different topics that interest them. Since they are so much more knowledgeable than the students (and often the teacher) the mentor's role is to help focus students' thinking on an

investigation that is likely to be feasible and yield some interesting results. Asking a few diplomatic questions at this time can have tremendous payoff.

Selecting a research topic and refining a question can take considerable time for students; but when this is done, mentors have the opportunity to "encourage them to go and look up things and to think about things critically." (Mary Brackenridge). As Paula Lowell, a university professor, explained:

> [I see my mentees] as a group kind of going off on the wrong direction, and I am thinking, "Oh, my gosh! How am I going to do this? I am not even *with* them!" [But] by just asking them a couple of questions, not only did they get on the right track, but some of them really, really dug into the area and got a lot more information.

Once students are clearer about what they want or need to know, and especially once they post draft work online, the mentor's role shifts to that of a responsive and critical audience. Now, a mentor gets a chance to offer tips on improving or enriching the ongoing work. This is a challenge that many of our mentors looked forward to and took pride in, because it allowed them to exercise their professional know-how. Thompson, for example, would advise his mentees that "one of the best ways to argue is to defuse a counter-argument before somebody brings it up. So, put it in your essay". Don said that he "[tried] to point [my mentees] in directions that they hadn't thought of, or at least ask them questions that they had to ask themselves."

Ideally, a mentor participates throughout the course of the students' inquiry. Unlike a one-time visit that may quickly be forgotten, one of our mentors described a telementoring relationship as

> ...more like interacting with students on a field trip. There's not much of [the] standup lecture part of teaching in this kind of experience, but it is good in terms of developing [your knowledge of] when to ask the right questions...and when to just...listen and let the students figure it out.

Learning more about teaching, and about yourself

The previous quotation touches upon a theme that was quite prominent in our interviews. While it may have been important to our volunteers to promote interest in their fields or the organizations they worked for among the young, the great majority of them (12/13) also recognized the value of telementoring as an opportunity for their own growth and development. Some were especially interested in knowing how students are using new technology in the classroom, or were curious about what students today are taught. Thompson, for example, wanted to know "how much they [students] do know and how quickly they grasp the subjects", as well as the science subjects they are interested in.

Some volunteers were more interested in honing their own teaching skills. A number of them were planning to become teachers themselves someday, so they were eager to sharpen their skills in an way that entailed fewer responsibilities than full time teaching. They were, in effect, looking for an opportunity to test their mettle as digital-age teachers. Paula Lowell, a university professor, explained:

> For me, the computer is a tool that I need to use to get my job done. I'm not one of those people who's real fond of the computer. I thought, "well, I'll try this and see what it's like to interact with someone over the computer, to see if I can be effective, and if it's very different."

When telementoring relationships are initiated and sustained in shared electronic workspaces like Knowledge Forum®, volunteers may also be able to pick up some pointers from fellow mentors working with students in the same class. For example, at one point during her first telementoring relationship, Jodi Borden found herself at an impasse with her mentees. Unsure how to respond, she was able to gain some insight by browsing through the telementoring dialogues of her peer mentors:

> I started, I guess, peeking in on some of the other discussions [between the mentors and mentees] to see what level of assistance was going on.... Because you want to be encouraging, but you also [are tempted] to say, "you're really out of line here, way off in left field." How do I be polite and try to encourage [my mentees at the same time]?

Like many of our volunteers, you may find that telementoring stretches your capabilities in a variety of ways that remind you of how far you've come in your own development.

Giving back

In a related vein, a number of our volunteers appeared already to have given significant thought to the course of their own development. They saw in telementoring a way to "give back" either to education generally, or more specifically to the field in which they had built their careers. Thompson, for example, was inspired by his relationship with a professor whom he regarded as a mentor. As he explained, "I would like to create that [type of experience] for other people, because I know what it can do for me." Further, he hopes that his efforts will have a ripple effect: "Maybe in the future these guys will go back and do the same thing for somebody else." Regretful that he did not have early access to a mentor himself, he hopes that he can prevent this opportunity from being lost to other students.

Realizing the potential of the Internet

Finally, nine of our interviewees specifically mentioned that they were motivated to volunteer as telementors, in part, because the project used Internet technologies in a way that intrigued them. For example, part of Hawkins' initial enthusiasm for telementoring came from the opportunity it presented to examine first-hand, the potential of the Internet to enhance her own teaching. In the end, she was so impressed by her experience that she became motivated to experiment with her own college freshmen and sophomores. Similarly, Mary Brackenridge became confident that she could carry out similar work on-line with her colleagues, because she now has a "tangible example of how it might work." As she herself says, "I feel like..[it] has more potential than I thought that it did". This was a substantial change from the skepticism with which she began:

> I wasn't sure how dynamic it would end up being, or whether it would kind of fall flat.... [But] I was actually impressed at how much the students would log on and discuss things, [as well as] the range of the discussion among themselves. I was pleased with that.

Not all of our interviewees connected the experience of telementoring with their paid work, but the majority (9/13) appear to have developed a deeper appreciation of how the Internet might be used to improve their own lives or the lives of others in some way. Randy Roberts provides a vivid example:

> There's something [about telementoring] that just resonated with...the initial excitement that I felt when I first started finding out about the Net. You know, the concept that people were envisioning situations not unlike this, where very isolated...school environments all over the world literally are...supplementing the teacher's curriculum with a level of expertise that they may not have ever been able to acquire in any other way. That was one of the really exciting things about it [for me]. And the other thing, of course...was the idea that this new medium could really go along way in the democratization of...cultures that traditionally have not been that way. So it was pretty exciting.

These interview excerpts have been included to illustrate that aside from its benefits for students, telementoring can serve a variety of purposes for volunteers and the organizations in which they do their paid work. Because volunteers do not need to leave the workplace to participate in telementoring relationships, they provide a very efficient means of cultivating the interest of students in fields of study, and work that they might otherwise learn little about at school. At the same time, telementoring provides adult volunteers with unique opportunities for personal growth and development — opportunities to learn more about themselves, to give something back to the community, and to help shape the world we live in for the better. In the next Chapter, we will present several true stories of volunteer telementors, both new and experienced, and their efforts to realize the potential of telementoring with young men and women studying science.

Chapter 2: True stories of telementoring relationships

In the Introduction, we explained how telementoring differs from several traditional ways that adult volunteers have been involved in education. We also walked through a brief example of a telementoring relationship, to give you an idea of what such relationships are like and how they develop. Of course, a single example is hardly enough for a would-be telementor to get a clear sense of the objectives that telementors should strive for, the challenges they face in achieving them, or the rewards involved in facing these challenges.

In this Chapter, we share six more true stories of telementors, their mentees, and their experiences together. We selected each of the stories to illustrate one or more important points about the role a telementor plays in supporting ambitious classroom inquiry. While these stories cannot capture every challenge that telementors face, they should prepare you to manage many of the most common ones that our volunteers have faced in the past.

Harry: Understanding the role of an inquiry guide

Harry Kong was a Ph.D. student in Biology who was looking forward to a career in teaching. He had served as a teaching assistant once or twice in university, but wanted additional experience in working directly with younger students; so telementoring seemed like just the thing for him. At the time of our interview, Harry had just completed his second telementoring experience with a small group of high school students in Toronto. His mentees were four outgoing students who were anxious to study his own research specialty, cloning. In an early note to Harry, two of them wrote:

> Hello! We are Rhonda and Kathy, two grade 9 students at the Woodside School. We are looking forward to exploring the possibilities of cloning and learning more. We're very enthusiastic, and it seems you are, too. We hope we can work well together and use this as a great new experience!!!

Note that this posting, while friendly and upbeat, doesn't reveal much about the specific curiosities, or the knowledge the students bring to their work. Since Harry knew that students normally haven't studied cloning by grade 9, his reply suggested that all of the students read up on a few different cloning techniques.

Unfortunately, Harry didn't take the opportunity to ask any questions about who his new mentees were, or what they knew. Neither did he say anything more about himself than he had mentioned in the short biography he posted for all of the students, which focused almost entirely on his professional qualifications and subject-matter knowledge. This was an important missed opportunity for Harry. Asking friendly questions and dropping biographical details are strategies that many good telementors use to help their mentees feel more comfortable about sharing their interests and exposing their ignorance.

As the students' work progressed, Harry's postings continued to be more or less businesslike and socially distant. In fact, he spoke only when spoken to. One of Harry's mentees later described their relationship in an interview as "pretty much student-teacher. He never said more than he had to, really." This remark is a fair summary of their correspondence, and says a lot about how Harry acted out the role of a mentor.

In our interview with Harry, it became clear that as he understood it, the major challenge of telementoring was to provide authoritative answers to questions about subject matter. As he said, the main challenge for him was

"trying to find out some way to communicate with high school students, in such a way that they understand, and which is also correct." Harry's correspondence with his mentees, and their reactions to it, suggests a different problem, though. While Harry did a good job of explaining complex scientific ideas in layman's language, he repeatedly passed up opportunities to find out more about his mentees, how they were thinking about their research, or how that thinking might be improved. In their responses to Harry's notes, the students would exclaim, 'Oh, *now* I understand!' but when the time came to display what they knew, their initial questions resurfaced. Each time, Harry offered direct and carefully-worded answers, but failed to challenge his mentees' thinking or offer a starting place for further conversation. Here, for example, are two complete notes that were passed between Harry and one of his mentees:

> Student: I have a question. What's the difference between cloning and transgenics?
>
> Harry: Cloning usually means to create a genetically identical offspring. A transgenic animal usually has its genetic make-up modified: its DNA is somehow altered.

One important observation to make here is that there was no *momentum* to Harry's dialogue with his mentees. To them, it seemed that they were always starting the conversation over again from scratch; and *they* were always the ones who had make the effort. One student explained:

> I thought the mentor would be, kind of like a guide. A person who would...point you in the right direction...if you were having trouble or something. Or, if you needed someone to start to focus your research, then the mentor, being the expert, would give you the direction to go.

While Harry might have *wanted* to play the role this student described, he could not, because he simply didn't know enough about what his mentees were doing and thinking to offer direction. We refer to this as the "low visibility" problem, and it is very common. On rare occasions students will spontaneously explain where they think their work is headed and what challenges they are facing; but most students simply don't know how to do this. In these cases, it is up to mentors to *ask* about whatever they need to know to figure out where students are headed, and what the best route will be for them to get there.

This story is not intended to put Harry in a bad light. Many of the challenges he faced are ones that every telementor will confront, and we will revisit them in other stories. What Harry's distant relationship with his mentees demonstrates, though, is how easily a telementoring relationship can degrade into an exercise in "asking the expert" if the mentor doesn't build sufficient rapport to maintain conversational momentum, and ask enough of the right questions to offer informed advice. Harry's biggest problem, it seems, was that he had too limited an idea of his

role. Because he thought of himself as more of an “answer man” than a guide, he probably didn’t think it was appropriate to befriend his mentees, or to challenge their thinking. In the next story, we see will how a volunteer with less experience than Harry was able to engage much more deeply with his mentees by asking the right questions, and by combining a little pleasure with business.

Carl: The importance of rapport

Ken, Mike, Sandy and Coleen were four students in a grade 9 science class in Toronto. For their major research project of the school year, their teacher offered them and their classmates a number of fictional decision-making scenarios to study. In each scenario, students were called upon to play the role of a policy analyst concerned with cutting-edge developments in biological research and the environment. The students were free to choose any one of these role-playing scenarios, which were designed to give direction to a research unit lasting several weeks. A dozen volunteer telementors were recruited to support the students' work, with one volunteer assigned to each scenario.

Ken, Mike, Sandy and Coleen chose a scenario concerning a hypothetical anti-aging drug, and the ramifications of introducing it for sale. Over a period of weeks, they and their mentor Carl Thompson, a Masters student in the Exercise Science Program at the University of Toronto, gathered, sifted and debated evidence using a shared electronic workspace called Knowledge Forum®. This system bears some similarity to a discussion board, but has a number of additional facilities that make it more suitable for lengthy collaborative research of the kind the students were doing.

Carl had never worked on-line with K-12 students before; but his story provides a good illustration of some of the strategies that skilled telementors can use to engage effectively and productively with students.

Getting to know you

Like the other mentors involved in our work that year, Carl introduced himself to his mentees by posting a biography in the Knowledge Forum® database. Carl's bio detailed his academic and professional background; but it also mentioned skills and interests that he had developed outside of school. Here are some excerpts from Carl's posting:

> My courses [for my Masters] focused on biochemistry, anatomy, biology, exercise physiology, and nutrition/metabolism. In my spare time I work a part-time job to help pay for my studies. ...I was a Big Brother while I was [doing my bachelor's degree, and] I was [also] a President (3rd year) of my residence (probably one of the best experiences of my life). I play guitar (6 string acoustic), and one of my favorite jobs here at UofT is working as a TA (teaching assistant for 1st and 2nd year classes)...
>
> It may seem that I do a lot of things and that I'm always on the go, but I have a lot of lazy days, or days where I just don't want to be in the library or the lab.

It was probably the openness of Carl's biography that made his mentees feel safe in expressing their insecurities about the subject matter they were working with. For instance, when Carl asked the students to tell him what existing knowledge they thought they could draw upon to help them in their research, Mike responded:

> Uh...let's see...background information...um....i have a really general understanding of DNA structure (don't know if that helps), and some understanding of genes.

Carl responded to Mike's note right away, reassuring him that his general knowledge of DNA and genes would be useful in the task at hand, and subtly pointing out specific areas in which to enhance his knowledge. Equally important, he took the opportunity to probe Mike's thoughts about the anti-aging scenario. While his question is informal, it does work to maintain the momentum of their conversation:

> It may help you to have an understanding of genes and DNA, specifically telomeres (a structure) and telomerase (an enzyme). I will try and help you out with that. While we're on the subject, what are your opinions on an "anti-aging" drug?

Carl applied this strategy of calming insecurities and probing for ideas with his other mentees as well. In reply to another student, Sandy, who had confessed to being a poor speller and disliking math, he wrote:

> Don't wurry, yor spelling if OK (just kidding) your spelling is fine, and your grammar is better than some of my second year students! You're right, this project will have a lot to do with science, but probably not so much to do with math, which is fine by me. The project will probably go beyond "pure" science and consider some of the larger social, moral and financial issues. What do you think some of those might be?

Carl shows us that while every student is unique, a mentor can get pretty far with a few good advice-giving strategies, followed consistently.

Mixing pleasure with business

Over the years, many of our volunteers have been surprised at how limited their mentees' access to computers is, even at school. If they are lucky, some of our students may get to an Internet-capable computer for just a few

minutes per day; so it is important that their on-line time be productive. However, Carl's story shows that a little polite conversation can go a long way in maintaining a good working rapport with your mentees.

As the students' research began to heat up, one of Carl's mentees ended a note by quoting some lyrics from a rap song. While he could simply have ignored this, Carl chose instead to mention it in his response: "Okay, I have to make one thing clear -- my knowledge of rap, Hip Hop, R&B, and dance doesn't go much beyond what's on the radio." He then returned to the work at hand: "I think you are right, women would be reproductively viable for a longer time [with the anti-aging drug]." After detailing some of the reasons for his thinking, however, he ended his note with a song lyric from his own high school days, as a kind of trivia quiz for his mentees.

In the weeks that followed, Carl continued to play this music trivia game with the students, while keeping pace with their thinking about the anti-aging scenario and the positions they were each planning to take. Along the way, he recommended books, web sites and other materials that were relevant to this work, and he provided individual feedback to each student on his or her progress.

Being reliable

Carl's feedback was valued by his mentees for a number of reasons. One was the consistency of his timing: he posted his reactions to his mentees' work within 1-3 days, without fail. Naturally though, the substance of Carl's advice was important, too. Ken remarked with satisfaction that "[Carl] took a whole note explaining what went wrong [in my paper] and all that stuff. And I had to correct it, or else my paper would just have been foolish." Carl had helped this student to understand, apparently for the first time, when and how it is possible to strengthen an argument by acknowledging counter-claims:

> There was this one section [of my position paper] where it was really weak. I don't quite remember what [the point] was, [but] it was really weak, and my argument was kind of against it actually. [Carl] told me, "well, I actually understood this", [but] I should have some of my arguments, the pros for it, 'cause I was arguing [some] for [my position] and some against it. You [should] set off the stuff against so, you're showing that you understand there are reasons against [your argument]. There was this one part [of the paper] where I think I wrote something against [my position], but I couldn't, set it off. I couldn't write it off. It was kind of against my whole argument, and made my paper rather useless actually. ...I had to...do more research.

Similarly, Sandy remarked that

> [Carl] helped me to organize my thoughts. 'Cause just by the natural way of my personal train of thought, it will go off into the middle of nowhere very quickly. He helped me to sort of to stay a bit more focused than I usually would.

Lessons

We may ask ourselves why Carl's first experience as a telementor seemed to be so much more positive than Harry's. Was it his knowledge of music trivia, or the fact that he has so many interesting personal experiences to write about in his bio? To be sure, Harry and Carl are different people who brought different stocks of personal resources to their work; but many of the things that Carl did right could be emulated by Harry, or by anyone.

While they enjoyed playing music trivia with him, Carl's mentees valued him as a telementor because he gave them useful advice. While Harry probably had as much content expertise as Carl (and probably more), Carl was able to provide more pertinent advice because he kept pace with his mentees thinking more effectively. This, in turn, was made possible because of his excellent rapport with them. So, while curriculum-based telementoring should not devolve into coffee shop gab, it is important for telementors to invest effort in developing and maintaining good rapport. In doing so, mentors have an opportunity to draw upon *all* their personal resources, not just their academic ones. You may not play the guitar or follow rap, but there's bound to be something you can talk with students about besides their research.

With good rapport and consistent, individualized feedback, a telementor like Carl can accomplish a great deal with students in a relatively brief span of time. Carl and his mentees were together for just 37 days, but the way they talked about him, you would think they had known him all year.

Mary: The importance of early and timely involvement

Mary was a doctoral student in Geology at the University of Chicago, who volunteered for the first time in the same year that Carl did. While Carl was working with his mentees on the anti-aging scenario, Mary advised seven different students who had chosen to study a fictitious plan to export large quantities of water from Lake Ontario. In the scenario, students were asked to play the part of a national group of scientists considering the impact that bulk water exports would have on the health of Canada's freshwater supply.

Like Carl, Mary had considerable expertise to bring to bear on her scenario. She was also quite personable, and proved artful in building on the experiences and interests that the students brought to their work. In the end, however, she did not play a very strong role in developing and refining her mentees' ideas. As we will see, the crucial element was timing.

Despite her considerable expertise, Mary did not get involved in her students' thinking as early as Carl did, nor was she as consistent as him in providing feedback in a timely way. Not all of this, it should be said, was her fault. Unfortunately, she fell ill with the flu near the middle of the students' research unit, and was not able to get on line. During her lengthy absence, her mentees supported one another with information and resources; but they missed the benefit of Mary's expertise in shaping their investigations. Though ultimately Mary did provide personalized feedback to each student, most of these excellent suggestions were not pursued due to shortness of time.

After choosing the water export scenario, Mary's seven mentees each introduced themselves. They explained a bit about themselves, their favorite subjects at school, their other interests, and why they chose the water export scenario. Here are some brief excerpts from one of those biographies:

> Hi. My name is Adrian. I am in grade 9, only I wish I was still in kindergarten (naptime rules!!) ...Science isn't...one of my favorite classes. I do sort of enjoy one real subject though. FRENCH. I don't know what it is about it, but it comes so easy to me...
>
> [My parents] own a cottage on a lake, and I know how precious our lakes are to us. My lake...was really polluted and two summers ago, everyone on the lake was helping to clean it up. ...Now we take a lot of pride in it. If the government wants to sell water from our lakes, there would be alot of very angry people (including me).Well, please respond soon.

When she felt well again, Mary responded:

> Comment vas-tu? I like French too, and it is great to have another language. It has really helped open up the world for me.
>
> So, why are people angry about the idea of selling water? Should we be worried? What would happen if billions of liters were removed from Ontario's fresh water system? Would there then be a shortage? Would it affect the quality of what is left? Would your lake be affected if water is taken from another lake?
>
> cheers, M

Here, Mary made a solid effort to connect with Adrian and her interests, both in and out of school. She also asked a number of excellent questions to help Adrian test and overcome assumptions she might be making about the problem framed in the scenario. While it isn't obvious here, Mary had a long term plan in the back of her mind to teach Adrian and her classmates about the interrelatedness of lakes through the ground water system, and the relationship between water levels and the concentration of pollutants. In a later note she wrote:

> Hi Ashley and Sandra,
>
> You've both talked about water transfer from one lake to another. Water transfer from one lake to another does take place. One way this occurs is through canals that humans construct. A big issue is about water transfer between catchment basins, and even between sub-basins, because it can alter the flow patterns in the basins. Another thing to keep in mind is that lakes aren't just connected by rivers, but that they are interrelated through the ground water system as well - look up a section on the water table in a geography or environmental geology textbook.
>
> Also, you've brought up a good point about the legal trade precedent involved in selling water. You'll find some discussion about water as a potential trade commodity at the Canadian Environmental Law Association Water Watch web page http://www.web.net/cela/ww-index.htm

In other circumstances, this advice would have set Ashley and Sandra off to a promising start; but here it came a few days too late. As a result of her illness and other delays, Mary's first posting came almost *two weeks* after the students had posted their biographies; and by this time, most of the students had already committed themselves to a path for their research. Few of Mary's excellent suggestions were followed up.

A quick inspection of the shared workspace shows that Mary contributed 14 of the 65 notes posted by the water export research group over a five week period. This is a sizable proportion (22%); but their impact was minimal

because they were massed into just five days. Mary's mentees certainly appreciated the effort she had put forward, enjoyed talking with her, and would have liked to take advantage of her expertise. However, like most conscientious students they had budgeted their time for their research carefully. When Mary's suggestions came, it was too late to take full advantage of them.

Lessons

We can draw two important lessons from Mary's experience. The first is that a telementor's suggestions and advice will always have greater impact the earlier they come. This is why it is so important to set aside a little time for your mentees every two or three days. A little effort invested every other day will have much greater benefit than the same number of minutes of massed together at the end of the week.

The second lesson is that students are often just as pragmatic about their school work as adults are about business. While we may not like it, the school context often puts deadlines and students' curiosities in competition with one another. This is why it is important to be aware of your mentees' due dates for their work, and keep them on your own calendar. This way you can have a much better chance of targeting your advice for the times when it will be of maximum benefit.

Jodi: One strategy does not fit all

In its popular usage, the word “mentoring” usually implies a one-on-one relationship. As we have seen in the previous stories, however, curriculum-based inquiry telementoring is usually not one-on-one. In practice, telementors most often guide the work of three, four, five or more students at a time. This poses some interesting challenges, one of which we will see in this story.

On some occasions, the students working with a particular mentor act as a team. In other cases, each student is working toward a slightly different learning goal. In the latter case, mentors are called upon to follow several strands of inquiry at once, and do their best to help each student face whatever challenges arise along the way. This story is about a novice telementor named Jodi Borden, who did an artful job of offering guidance to several students in their studies of medical forensics.

Jodi was familiar with the field of medical forensics from her work designing exhibits at a large science museum. Over a period of several weeks, she followed the work of six Toronto-area high school students as they refined research questions, carried out their research and put together individual written reports about different questions within this field.

Within her first two weeks of working with the Forensics students, Jodi exchanged notes with each one individually. An excerpt from one of the students’ biographies gives a good impression of what these exchanges were like:

> Hi, my name is Marshall and I’m a grade ten science student at Woodside. I chose Forensics because it seems interesting to me. I am sort of interested in how DNA testing works. I can’t really formulate a question yet, but as soon as I get more familiar with forensics, I will formulate one for the final paper. I really don’t have much science background that would help me, probably except from what I see on TV, if that counts.

Like many of his peers, Marshall approached his study of medical forensics with only a broad idea of what interested him about it. The challenge for Jodi was to decipher what he and her other mentees were most curious about, given that most of them stated their interests as vaguely as Marshall’s in their initial postings. Jodi’s response to Marshall’s note is a good example of how a telementor can help students focus their efforts by offering up a number of feasible agendas:

> Just wondering if you have narrowed down your research topic yet. DNA testing is a pretty broad field. Are you interested in its applications (i.e.. paternity, trade in endangered animals, to link someone to a crime)? The ethics of it (should every criminal be required to give a blood sample and his/her DNA 'fingerprint' kept on file)? The statistical reliability of it (what does it mean when an expert witness says that the pattern in DNA is only found in 1 out of 100,000 people). What about the different techniques used to determine a DNA fingerprint? Any of these sound interesting, or have you already made a choice?

As this note suggests, many telementoring relationships start with a kind of negotiation. For their part, the mentees are often not sure what they are interested in, or what may be feasible for them to investigate. Likewise, mentors aren't sure what students are curious about, or what they might be capable of accomplishing. However, these issues can be cleared up in time if both parties are communicative and open-minded.

Another of Jodi's mentees, Marissa, presented a greater challenge than Marshall. In her first note, she had said she wanted to study DNA testing; but as time went on, she changed her mind repeatedly. A few days after her introduction, she claimed she was curious about how scientists can determine the cause and time of a person's death. Still later, she became interested in fingerprints. With each new research agenda, Jodi tried to encourage Marissa to dig deeper by offering a set of questions to guide her thinking. Here's an example:

> You're talking about regular fingerprints - not DNA fingerprints right? As far a I know, fingerprints can't determine someone's size. They don't really even indicate someone's age or sex. If you've found something to indicate otherwise, I would be interested to see it... always looking to learn something new. Fingerprints are different for everyone (even identical twins don't have identical fingerprints - although they have identical DNA fingerprints). Which might make an interesting angle to your paper. How are fingerprints formed? Do they form when you're a baby? What are the different types of fingerprints (They've been classified into types)? Can you lift a fingerprint from inside a glove? How do they find fingerprints at a crime scene?

Unfortunately, Jodi's notes didn't have the effect that she was hoping for. Each time she posted her questions, Marissa responded a few days later by suddenly changing her focus. As the research unit drew to a close, Jodi sensed that Marissa needed more direct guidance. She later explained in our interview:

> She'd never really respond to the questions that I'd asked her, to try to get her thinking. So I was never sure if that approach was working. She went off in a different direction, took a different tack. So it was sort of, you know, every time you wade back into this you think, "OK, well, you're going off here, let me see if I can encourage you." And I guess I couldn't find another way of communicating with her that might help her. [Her case] was one of the more frustrating, just because it was all over the map.

In retrospect, Jodi realized that Marissa was probably taking her questions the wrong way. Rather than thinking of them as starting-places for her

research, Marissa seemed to take each set of questions as a criticism of the agenda she had chosen. Rather than grabbing onto the questions and working with them, Marissa responded by trying to formulate an agenda that Jodi wouldn't have *any* questions about. In retrospect, Jodi might have had a better reaction if she had said explicitly "This sounds like a workable agenda. Here are a few questions that might make good starting places for your research".

Jodi's questioning strategy was more successful with her other mentees, though. Another student, Rachel, seized upon Jodi's questions eagerly, and wasted little time in deciding on her focus. Rachel actually posted her first note a week later than the rest of her peers, but appeared to have thought about her topic a good deal in the interim:

> I often wonder, how is it possible that every piece of DNA is different, and how are they so carefully differentiated? I also wonder about how [DNA testing] is actually done, like the procedures followed. I hope to find the answers during this research project.

In response, Jodi asked several questions, in order to clarify what Rachel was curious about. She also offered some references to help Rachel in deciding. While this strategy didn't work very well with Marissa, Rachel responded to it well. She acknowledged Jodi's questions right away, and explained that what she was really interested in was understanding how DNA evidence is analyzed. In contrast to her experience with Marissa, Jodi could tell that she was getting somewhere:

> Jodi: [Rachel] was actually looking at what I was talking to her about. [That was] gratifying. [I thought], "Great! Somebody's listening!" (Laughs)

Once she was clear on where Rachel was headed, Jodi wanted to make sure she was aware of the historical, legal and scientific facets of her subject. When Rachel posted the first draft of her position paper, for instance, Jodi could see that she had a mistaken idea of how decisive DNA evidence can be in a court case:

> In your conclusion, you are pretty black and white about the benefits of DNA fingerprinting in forensic science. Are there any down sides? I believe that forensic science is about providing evidence to a court for their determination of guilt or innocence. DNA fingerprinting is very rarely enough on it's own to do that...there has to be other evidence to back up the prosecution's case.

In other instances, Jodi tried to widen her mentees' views of their work by drawing attention to what she was discussing with their peers in the Knowledge Forum® environment. In our interview, she explained that the thinking behind this strategy was partly pedagogical, and partly pragmatic:

Interviewer: You were sort of trying to stitch together all the threads of discourse, in a way that I thought was pretty unique.

Jodi: It's probably laziness, too. [This way] I don't have to type in all those links again. But it also started to build. Like sometimes, the student would come back and say, "oh yeah, I found this [web] link." And then they started posting general links [for everyone]. Had I thought about it a little bit more, I guess...I would probably do that same thing.

Lessons

Jodi's experience illustrates some of the challenges a telementor can face when working with students on related, but distinct agendas. As we saw in previous stories, effective telementors employ a variety of strategies for motivating students and helping them to explore their interests; but not all students respond equally well to the same strategies. For this reason, it is important to keep track of how each of your mentees is progressing, and to change your tactics when they don't seem to be responding.

Jodi's experience also shows how important it is, when posing questions for your mentees, to be as clear as you can about the purpose they are intended to serve. In a telementoring dialogue, questions can do many different kinds of work. You may expect direct answers to some of your questions, while you ask others simply to help students map out the territory that is open for them to explore, or understand the depth and complexity of the subject-matter they are working with. In the next story, we will see another mentor making use of careful questioning to lead students deeply into subject-matter.

Dan: Your partnership with the classroom teacher

This story is about one of the more successful telementoring relationships we've studied. It revolves around Dan, a Ph.D. student in Physics, and three Chicago-area high school Earth Science students named Andy, Cori and Bill. Like everyone else in their class, the three students were starting a ten week investigation that would make up a significant part of their course grade. After reading a news report about a "new" black hole being identified, they decided they wanted to learn about how astronomers identify black holes. They were curious about how astronomers could tell a "real" black hole from something that looked similar to one through a radiotelescope.

We chose to include this story here because it offers a nice illustration of some of the forms of research guidance that a good telementor can offer students. While Dan's relationship with Andy, Cori and Bill was not "perfect", it does provide a model of thoughtful telementoring in at least three ways. First, Dan makes it his business to support the teacher in achieving his teaching goals. Second, Dan recognizes and thinks carefully about the limits of the help he can offer to students at a distance. Finally, as he is crafting his advice to his mentees, he weighs the potential benefits of taking one possible course versus another. He doesn't simply offer the first advice that comes to mind.

Framing the Investigation

Dan's ten week relationship with Andy, Cori and Bill began with a brief exchange in which the students told him a little about their research idea and asked if he was willing to help. Dan responded by expressing his enthusiasm, and gently probing them about what relevant course work they had completed in school. From the outset, Dan was a little concerned that the subject of black holes might be beyond the understanding of high school students.

After the first few messages, Dan and his mentees got right down to the business of designing an investigation about black holes. The first major challenge they faced together was to put together a research proposal that would satisfy the teacher's requirements. Mr. Wagner insisted that in his classroom, every research report should make a non-trivial claim about a natural phenomenon. That is, it should present a believable analysis of some actual data — numbers or observations — that either came from reputable published sources or measurements that the students themselves

had made. It shouldn't simply summarize what researchers or textbook authors have written.

In their message below, the students use the word "infomercial" to describe the sorts of projects that Mr. Wagner routinely rejects (italics added):

> Dear Dan Jeffries,
>
> I'm glad to know you'd be interested in helping us. I hope you got our information on our educational past. We need to come up with a thesis proposal. We submitted several proposals which weren't accepted because they didn't fully meet the thesis requirements. Here's the bind: *We must have a topic question which will not turn our project into an infomercial. ...We need specific data (however much data on Black Holes is complex Physics which we can't use/understand)*
>
> We're thinking of the following type of project proposal. Finding several reports on Black Holes which may exist. Using the data we know (in simplified terms) we will evaluate the data known on this these supposed black Holes. We will then conclude whether any of these can truly be black holes (dependent on whether they meet our "requirements for black holes"). This case study will require transferring a great deal of complex material into simplified, workable terms. Perhaps this is an area that you may be helpful in. Please write us and tell us if such information we're looking for exists and is workable, or if you have any ideas for our project. Your help is greatly appreciated. Keep in touch.
>
> thank You,
>
> Andy, Cori and Bill

In his reply to this message, Dan offers advice on three fronts. In the first paragraph of the following message, he points Andy, Cori and Bill to publications where they are likely to find reading materials on black holes that they will be able to understand with their limited theoretical knowledge. In the second paragraph, he cautiously suggests that with the right limitations, their black holes agenda could satisfy Mr. Wagner's project criteria. Finally, he reminds them that it is not too late to choose something simpler to investigate, and suggests that they may find some inspiration in an Astronomy magazine called Sky and Telescope:

> Andy et. al.
>
> I don't think I gave you the month on that Physics Today article, I'm not sure of the month but it's number 8. I would assume that's August but I'm not sure if PhT puts out 12 issues a year. Once again, I'd look at Sky and Telescope or Astronomy first. I talked it over with a few of my colleagues, and they suggested that Physics Today might be too advanced.
>
> As I understand it, your problem is that you cannot just say "This is what a black hole is, isn't it cool", but you have to come up with some verifiable, answerable question. The process used by astronomers to determine if a source is a black hole isn't all that trivial. If you do not have to go into how they measure the velocity of the surrounding material, that might be do-able. Still, there are only three sources that have been conclusively identified as black holes. (And one of them was just announced days ago.)

> In addition to looking at the idea of how the existence of black holes is determined, you might also ask yourself if there are any other astronomical questions that you are interested in. You might look through a few back issues of Sky and Telescope, and see what interests you.
>
> Let me know what you think.
>
> Dan

Weighing Challenge and Motivation

At this point, Dan was hoping that Andy, Cori and Bill might find something a bit easier to study than black holes. As he later explained in an interview, he had begun reflecting on the subject, and realizing that it was tougher to come to grips with than he initially thought:

> I [had originally] thought, sure, explaining black holes...no problem. You can do that without a lot of the complex math. But then I realized, there are a lot of important physical concepts that do need to be explained there that I didn't think about the first time. A lot having to do with...Doppler shifting. Things like, "just what is the nature of light itself?" that, on my first time thinking through this, I thought, OK this isn't going to be a huge hurdle to overcome. And as I [got] further into it I started realizing, wow! there is a lot of knowledge that you have to build up over time in that!

In the end, Dan had to balance his misgivings about the difficulty of the subject with the need to maintain his mentees' motivation to understand black holes. If he tried to force them to study a simpler phenomenon that simply didn't interest them, they might disengage.

When it became clear to Dan that his young mentees were not going to give up on the black holes idea, he began to problematize for them the nature of the "proof" they should be looking for with a series of questions. Asking these sorts of questions is one strategy that good mentors use to help students fully appreciate and get a grip on a problem:

> The basic questions you would want to ask are: What is a black hole? If it exists, where would we expect to look for it? What would we see? Has anyone looked for this, and what did they find?

With this help, and further consultation with Mr. Wagner, Andy, Cori and Bill managed to settle on the following plan for their data gathering and analysis:

Thu 7 Dec 1995

Dear Dan,

Thanks a great deal for your continual responses and input. Your help is much appreciated. We think we've found a nifty idea for our project.

First we'll briefly explain the features and dynamics of a Black Hole, talking about simple physics, formation of etc. Next we'll research the three known Black Holes and find information about how and why these areas were positively identified as a black hole. Next we'll do a "case study" on the areas which scientists think may be Black Holes. By comparing observations between the Black Holes and the "possible Black Holes" we can conclude which of these "possible Black Holes" are most likely to exist.

Some of the following information may help.

1. What are the names of the three Known Black Holes, where might information be found on them (we'll find it).

2. Where might information be found on the unknown Black Holes.

3. What "traits" in these Black Holes and supposed Black Holes would be the most simplistic and beneficial to helping us compare.

Once again Thank You Greatly,

Andy, Cori and Bill

Following this message was a lengthy exchange about the theory surrounding black holes and how astronomers collect and interpret data about them. In most of these messages, Dan did what the students asked him to do and "translated" what he understood about black holes into language that Andy, Cori and Bill could comprehend. Following students' requests in this way is not *always* the right thing to do; but in this instance, Dan was convinced that it was the best way to help Andy, Cori and Bill learn what Mr. Wagner wanted them to learn.

Providing Feedback and Closure

When the students completed their report, they shared it with Dan. Like many of the best mentors we've seen, he provided paragraph-by-paragraph comments on the work, ranging from friendly asides to fine points of clarification regarding the theory of black holes. Below is one of Dan's asides on part of the team's Introduction (the students' text is the top portion, Dan's comments are preceded by dashes). This excerpt illustrates how telementoring conversations can help cultivate students' curiosities in a very natural, incidental fashion:

> Black holes can vary greatly in size. Scientists have noticed compacted mass resembling black holes which span several galaxies. Thus, the mass of many galaxies may have imploded into one massive "hole". Single stars have imploded to create miniature black holes. Some of these miniature black holes contain the mass of earth in a space the size of a sand grain. it is believed that one of these miniature black holes may have encountered Earth in 1908 and caused a 50 mile stretch of forest to "disappear" in seconds.
>
> -- Sounds like the Tungaska incident in Siberia. This has been suggested to be
>
> -- many things. My favorite explanation (though not the one I actually believe)
>
> -- is the idea that it was an anti-matter asteroid. Tungaska is fun to speculate
>
> -- about.

In addition to more lighthearted comments like this, Dan offered minute reactions to the team's Data Analysis section. Here is one example:

> Cygnus X-1 however cannot be conclusively proven a black hole. Few common traits could be found between Cygnus X-1 and NGC4261/M 87. Although thought for years to be a black hole because it's density outmatched a neutron star's maximum capability, it clearly is not. However, Cygnus's density may have been miscalculated slightly. Assuming Cygnus X- is actually 20 percent less dense (this is quite possible given it's distance), then it is low enough in density to be a neutron star yet too large to be classified as anything else. Therefore, Cygnus is most likely not a black hole, but a neutron star instead.
>
> -- Given its distance, or uncertainty in the determination of its distance?

While he saw room for improvement in the paper, Dan was evidently very pleased with it. In particular, he complimented the students on their careful consideration of the evidence they had worked with:

> Interesting paper. You did a good job of making what conclusions you can from a limited data set. This is a must for anyone in astronomy. In the field, since there is almost always limited data, error analysis is crucial, as well as a healthy sense of skepticism. I think you did a good job of showing why the nature of Cygnus X-1 is in doubt. More information on what you would expect to observe from typical neutron stars would help to strengthen your claim that the Cygnus X-1 source is a neutron star. Good Work! I hope you had fun with this.

Judging from our interview, the students did seem to have had fun with their investigation. And, just as important, Dan did:

> 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.

Lessons

When we think about what made this relationship a success, it is tempting to focus our attention exclusively on Dan and the students. Certainly they each did a lot of things right, which their individual knowledge and effort made possible. However, it is important also to think about the influence that the teacher, Mr. Wagner, had over the course of the relationship, and

the role that every teacher should play in helping telementoring relationships to succeed. While teachers may not participate directly in telementoring relationships, they can do a number of other things indirectly, to help them flourish.

To begin with, Mr. Wagner set requirements for the students' investigation that gave Dan an appropriate role to play. If the students' assignment had been a more traditional book report, or an investigation of much shorter duration, Dan may have had very little opportunity to become richly involved. Mr. Wagner didn't simply match his students with their mentor and let them go, either: he was there to make decisions about whether or not the students' research proposal was solid enough to go forward, so that Dan was not forced to do this on his own. While Dan had ideas about what the students might be capable of doing, and to what level of perfection, only the teacher had intimate enough knowledge of the students to make a confident decision about this. Finally, during Andy, Cori and Bill's correspondence with Dan, Mr. Wagner offered the students a substantial amount of behind-the-scenes guidance and support himself. This included helping the students to interpret some of Dan's messages, which they weren't always able to understand easily. Even the very best telementor sometimes talks over mentees' heads unintentionally.

In our final story, we will see what can happen when the mentor doesn't have as clear an idea as Dan did about students are supposed to be learning from their research.

Jack & Eric: How much help is too much?

This story illustrates why it is important for a teacher, students, and mentor to share a clear idea of the learning goals for the curriculum piece that the mentor is providing support for.

Jack and Eric were students in the same high school Earth Science class as Andy, Cori and Bill. While they were not known as the brightest or keenest students in their class, Jack and Eric appreciated the opportunity that Mr. Wagner had given them to study what interested them most. For their second research project of the year, they chose a challenging agenda and worked hard to carry it off. Unlike some students who get in over their heads, the two boys seemed to understand the responsibility that came along with the freedom they had been given:

> Jack: [This class is] kind of, you're on your own. And I think you need a certain amount of maturity. I mean, we mess around and that — don't get me wrong. But when it comes down to the actual work, you've got to have some self discipline and go, "all right, this is for me. The teacher doesn't care if I work."
>
> Eric: It's good preparation for college, 'cause that's what college is like.

Starting with a vague curiosity about global warming, Jack and Eric managed to shape this curiosity into an empirically investigable question over a period of weeks, with the help of Dan and Mr. Wagner. They asked: is there a clear relationship between the mean yearly temperature for a city and the mean yearly ozone level in the atmosphere above it?

Once they had clarified this question, the most pressing problems for them became finding and analyzing data appropriate to it. At a minimum, constructing a dataset that would shed light on the question meant finding matching sets of ozone and temperature measurements for a number of locations over a number of years. Eric and Jack started their search on the Internet, but soon found it necessary to broaden their horizons. For a while, the prospects looked bleak:

> Jack: We went to Northwestern, we went to The University of Chicago...everywhere. We really put the time in for this, and we couldn't find the data.
>
> Interviewer: You actually went to the university library?
>
> Jack: Well, we went all through the Internet [first], but we're a little bit computer illiterate, so we couldn't really find it there. So then we were making phone calls, and we went to these places, and finally after all that, that's when we got with the mentor.

Despite not having the social grace of some of their peers, Jack and Eric seem to have made a pretty good start with their mentor:

Jack: We write him, and at first he's cool: "Yeah I would love to help. I know a lot about ozone depletion," da, da, da. He seems like he knows what he's talking about. "I would love to help you guys. Great, great." So we're like, "Yes! Finally a little help with this!"

The relationship heats up

While scarcity of data was a clear problem for the boys, they weren't simply looking for a handout. Their mentor asked them a number of clarifying questions about their research agenda, which they also appreciated:

Eric: He even questioned our question. He said, "Speculate. Is it this or that?" And you know, in a week he cleared it up.

Jack: Yeah, and everything was great.

Unfortunately, the relationship began to go sour as soon as the students asked their mentor for assistance in locating data resources:

Jack: Then we asked for the actual information.

Eric: No, we didn't ask for it. We said, "do you know where we can find this?" And he says, "I don't know if I want to tell you."

Jack: Yeah. He goes, "I don't have the information you want, and if I did, I don't know if I would tell you." What did he say, like a "science honor code" or something? Something like that. We showed Mr. Wagner and he was like, "What?"

Eric: It was like we were asking him for his mother's phone number!

What Jack and Eric experienced with their mentor has happened often enough that we have given it a name. We call it the "teasing dynamic". While it may seem harmless, this can have serious consequences, as it did here. When students make what they believe are reasonable requests of their telementors, only to be rebuffed with the assertion that "I know the answer to your question, but I don't think I should tell you," it can shatter the collegial spirit that a mentor should, ideally, be building with his or her mentees.

How much help is too much?

Often, the temptation to "tease" arises from a well-meant concern on the part of the mentor about offering "too much help", or "giving away the answer." Students are usually very sensitive to this issue, as Jack and Eric were in this case:

> Jack: We wrote back to explain what we meant, 'cause we didn't think we'd offend him. We go, "all we're looking for is this information, and we've had like a hard time finding it."
>
> Eric: It's not like we were asking for him to give us the answer, or the data. We were just asking for if he knows a place where we can check to find the data. I admit, it would have been rude of us to say "hey, will you send us the data?" But it wouldn't have killed the guy to at least mention a book.
>
> Jack: Or what he thought. Isn't that his job? Why would he want to be a mentor in the first place, if he didn't want to help us out?

Reading this, one might ask where Jack and Eric's mentor went wrong. Was it his job to help the students locate their data, or would this have been giving too much away? In this case, we and the teacher believed that it would not have been; but there is a more general issue at stake here: How much help is too much? This question often does not have a simple answer, though students, teachers and mentors alike may attempt to answer it simply. Sometimes, for instance, it is thought that sending data files always constitutes "bad" mentoring, while sending tips or web links is always good. This is a great oversimplification of the problem though, and it is important to understand why.

Lesson: Telling the mountain from the foothills

Because telementoring involves the exchange of messages over computers, it can easily be mistaken for a straightforward exchange of "information". This sometimes plays into an impoverished view of education which reduces teaching to telling, and learning to listening. In this simplistic view, the job of telementors is sometimes thought to be making mentees work for every clue they get: to tease them, or to badger them with Socratic questions.

Unfortunately (or fortunately, depending on your perspective), neither of these strategies turns out to be well adapted to the kind of curriculum-based inquiry telementoring that we have shown you here. The most frequent result of both strategies, in fact, is that mentees simply disengage. If every question leads only to another question, students quickly get the idea that they are wasting their time with you. As a result, you never get the chance to coach and guide students' thinking about scientific phenomena, research methods, or anything else that you as a mentor might be uniquely able to help them with.

To clarify the types of judgments that mentors are called upon to make when offering advice to students, we use the metaphor of "the foothills and the mountain". Imagine for a moment that you are a guide on a mountain-climbing expedition. Your climbing team includes your mentees and their teacher, who together (with your help) must decide which of the peaks in the range they are going to ascend, and what route they are going to take to get there. As the team's guide, you want to make sure they don't waste

their time and energy. It can be deadly to run out of food or fuel part of the way up the mountain; so your objective is to help the team find the most direct route to wherever they're headed. You especially don't want the team to waste their time and resources wandering around in the foothills, when they could instead be making an assault on the summit.

In a telementoring relationship, the "summit" is the problem of understanding that your mentees are attempting to solve for themselves. Other challenges your mentees face along the way are foothills. In Jack and Eric's case, given the learning goals that Mr. Wagner had laid out for them and the question they were investigating, the "summit" was a thorough and convincing analysis of temperature and ozone data for specific cities. While it is arguable that they learned something from driving around the Chicago area, searching for data in university libraries, this was merely a foothill along the way. Given Mr. Wagner's teaching objectives, their time would have been much better spent *making sense* of the data. As Jack himself said:

> Jack: We spent so much time finding [the data], and I didn't think that was the main goal. I thought the main goal of a scientist is to analyze all the data. To have, like A and B, and see how they relate.

The overall learning goals that telementors serve will vary depending on the teachers they work with; but if you should find yourself in doubt about how much help would be "too much", it should help to ask yourself four questions:

- what effort would this particular answer or piece of advice save the students?
- what learning opportunities would it forfeit?
- what learning opportunities would it make more accessible?
- which of these learning opportunities is closest to the overall learning goal for the students' work?

If any of these questions don't seem answerable, it is important to take them to the classroom teacher as soon as you can.

Summary of key lessons

The stories we shared with you in this Chapter carried several lessons. Here is a summary of some of the most important ones.

Rapport

Good rapport is important to a productive telementoring relationship. So, while telementoring dialogues should not devolve into idle chat, they should be friendly and should ideally connect academic interests to non-academic ones. A friendly and comfortable relationship makes it much easier for your mentees to be honest with you about what they don't know and what difficulties they are having. This is important, in turn, because it increases *visibility.*

Visibility

It is hard to offer informed advice to your mentees if you don't know who they are, where they stand in their investigation, and where they're headed. As a mentor, it is your job to *ask* about these things if students' do not think to explain them, or are unable to explain them clearly on the first try.

Questioning and advice-giving

Questions can serve multiple purposes in telementoring dialogue. They can be used to gather information, to generate awareness of a specific issue, or to complicate students' view of the world in productive ways. However, if you want your questions to do the work you intend, you should make clear to students what you are trying to accomplish with them. For example, if you are just throwing out ideas for consideration, say so. If you are expecting answers back, say that.

Keep track of how each of your mentees is progressing, and be prepared to change your advice-giving strategies if one or more students don't seem to be responding to them.

If you find yourself in doubt about how much help would be "too much", it should help to ask yourself four questions:

- What effort would this particular answer or piece of advice save the students?
- What learning opportunities would it forfeit?
- What learning opportunities would it make more accessible?

- Which of these learning opportunities is closest to the overall learning goal for the students' work?

If any of these questions don't seem answerable, it is important to take them to the classroom teacher as soon as you can.

Timing/scheduling

Bad timing can be the downfall of a telementoring relationship, even if everything else is working well. To prevent timing from spoiling your own relationships, you should:

- Be aware of your mentees' due dates for their work, and keep them on your own calendar.
- Set aside a little time for your mentees every two or three days. A telementor's suggestions and advice always have greater impact the earlier they come.

Chapter 3: Guidelines for crafting advice

The cases in the previous Chapter have hopefully given you a good impression of the directions that telementoring relationships can take, the challenges that can arise in them, and the ways that these challenges can be managed or overcome. Stories like these have the advantage of presenting lessons vividly and in context; but they also have a drawback. Because they present their lessons in a piecemeal fashion, they may sometimes leave you wondering what the "take-home" message is. For this reason, we will attempt to distill the lessons of the stories into a more manageable summary below.

Filtering your advice

It is important for all telementors to remember that the best-sounding and most well-intended advice is not *good* advice in the end if it cannot be, or is not *taken*. Effective mentors don't simply think about what they would do in a given situation and tell others that they must do the same — they present *options* and help their mentees to understand the potential merits and costs of those options.

Of course, nobody has limitless time and patience either to make up or listen to exhaustive lists of things they *might* do. This is why a vital part of the craft of telementoring is measuring up which possible advice is most likely to have real and evident value to *particular mentees* in a *particular situation*, and at a *particular time*. While it is not easy to boil down the performance of good mentors into rules, the best telementors we have observed over the years take at least five factors into account when deciding what advice to offer their mentees about an ongoing investigation:

- The *pedagogical point*, or overall learning objective at stake
- What mentees *already know* about what they are investigating
- The *time* available for mentees to carry out your advice
- Mentees' *motivation* to carry out your advice
- Mentees' access to necessary learning *resources* (books, journals, the Internet, etc.)

In the context of a particular investigation and set of mentees, these factors wind up being strongly interconnected; but below we will pull them apart and discuss each explicitly.

The pedagogical point

We saw in the Jack & Eric story how crucial it is for telementors to understand the overall learning goals for the work their mentees are doing. If mentors, don't share an understanding of these learning goals with their mentees, they are bound to face considerable uncertainty about what guidance and advice it is legitimate for them to offer. If they are lucky, this confusion will simply make them ineffective. If they are unlucky, it may generate active resentment between them and their mentees.

Over the years, we have seen some confused volunteers oversimplify the boundary between "too much help" and just enough. They may, for instance, make up a rule that it is okay to offer students hints about the terms to use in a web search, but not to provide specific URLs. Alternatively, they may think that it is fine to provide web links, but not to explain difficult concepts in their own words. In the end, however, these rules of thumb are no more than ways to avoid the question of what students are supposed to be learning. Whether or not it is right, in a given case, to offer students web links, or definitions for terms, or explanations of difficult concepts depends entirely on the teacher's pedagogical goals.

Here is where the relationship between you and your mentees' teacher becomes very important; because figuring out the learning goals for an investigation, making these clear to students, and evaluating whether or not students have met the goals are things that a teacher can do far better than a telementor. As a volunteer, you should feel that it is your right to ask the teacher as many questions as you need to understand what your mentees are supposed to be learning, and what the limits of your role are. Given the wide variation in the subject matter that students may explore and the kinds of investigations they may do, this may be impossible to get this entirely straight up front. Questions are bound to come up along the way, and when they do, you should ask them.

What your mentees know

In our interviews, students and mentors often use metaphors of exploration to describe both their investigations and their relationships with one another. In keeping with this metaphor, we often describe the role of the mentor for students with an analogy to a wilderness guide. We tell students, for instance, that their mentors should work with them like wilderness guides, to help them reach their destination. To do this, of course, a guide must know where their mentees are and where they need to go.

One of the trickiest jobs of a telementor, in this connection, is to figure out what his or her mentees already know that may aid them in carrying out the best investigation they can. This is important for a number of reasons,

some fairly obvious and some less so. Clearly, you don't want to talk over your mentees' heads if you can avoid it. Neither do you want to insult their intelligence. Both are bad for rapport, though neither is beyond repair.

Less obviously, mentors should not encourage their mentees to take set goals that they will not find attainable. Enthusiasm and effort can help overcome an initial lack of knowledge, but often a mentor is called upon to be the voice of reason for students who are trying to do too much. A good example here comes from the relationship between Dan and the black holes team. After asking about their background, Dan didn't feel confident that his mentees knew enough to treat their chosen topic as completely as their teacher would require for a good grade; so until Mr. Wagner approved their proposal, he continued to suggest ways that they could explore other agendas.

Even if your mentees' teacher gives you a good idea of the background knowledge the class has in the subject they are studying, there can be wide variations within a class. Your mentees may or may not fit the class profile. Asking them directly what they know can work well sometimes, as we saw with Dan and Carl. However, even "good" students aren't always well aware of the value their existing knowledge and experiences might have to a specific investigation.

Even when telementors can get their mentees to articulate their relevant experiences and knowledge, the slow turn-taking of asynchronous communication (as compared with face-to-face talk) means that they are forced to live with less complete information than a classroom teacher might have. This does not mean that telementors cannot render advice when it is needed, but that they may need to offer a variety of options, and rely on their mentees and the teacher to decide which of these should be taken.

Time

In an ideal world, every telementoring relationship would be like a Socratic dialogue. Telementors would have virtually limitless time to shape and guide their mentees' thinking. Like master gardeners, they would pull out fallacies, misconceptions and inconsistencies at their roots. For their part, mentees would be confident in exploring their deepest curiosities, and there would be no deadlines to prevent each and every investigation from following its natural course.

Unfortunately, the Internet is not the agora, and none of us are Socrates. Like it or not, academic telementoring relationships take place in the context of a packed curriculum that places strict limits on the amount of

time that teachers can invest in long-term inquiry. No matter how fascinating they may be, students' investigations must end on schedule, and students must be concerned with getting good enough grades to be admitted to the universities of their choice. Ironically, this context can make students averse to taking on the very sorts of challenging inquiry that lead to robust learning (Scardamalia & Bereiter, 1997).

One of the great promises of telementoring relationships lies in their capacity to support and scaffold students so that they can take on challenging academic work with less fear of failure. A good telementor does not merely cheer students on, though. Mentors who keep pushing for more work or harder work when a deadline is approaching are usually seen as unsympathetic and unworthy of trust. For this reason, a mentor's encouragement should always reflect an appreciation for students' deadlines and the insecurities they produce.

In the Introduction, we shared the case of Mandy and the earthquakes team. Mandy provides an excellent model of the kind of encouragement that telementors should strive to offer. She was always enthusiastic about what her mentees could do and learn, but at the same time she was pragmatic about their deadlines, and sympathetic to their insecurities. No doubt she had the students' due dates written down on her own calendar, and revisited them regularly. So should *every* telementor.

Motivation

The importance of students' motivation in the success of telementoring relationships is intuitively obvious. Students may begin an investigation with very little knowledge of the issues or phenomena they are studying, but if they are highly motivated, they can compensate by applying themselves determinedly and putting in lots of time. Likewise, students may begin an investigation with a great deal of background knowledge and a very clever idea; but if they rest on their laurels they may end up doing a poor job. Most of the mentees you encounter will lie between these two extremes.

As we have seen in the stories of Mandy, Carl and Dan, telementors can play a very important role in encouraging students to do their best work; but they need to be mindful of more than their mentees' motivation to take on challenging learning tasks. Another important consideration is students' motivation to invest effort in the telementoring relationship itself. The story of Harry illustrates how important the development of rapport can be in this respect.

Several of our stories have shown the significant investment that good mentors make in establishing rapport and trust with their mentees at the beginning of an investigation. This investment often pays off later on, when mentors may need to risk their relationship with students for the sake of the learning goals. For example, we have seen mentors who, faced with persistent low visibility from their mentees, "draw the line" by refusing to answer any more questions until their own questions are answered. This may not always work. The general point is that students are far more likely to be open and respectful toward someone they feel they *know* and *like*.

Access to learning resources

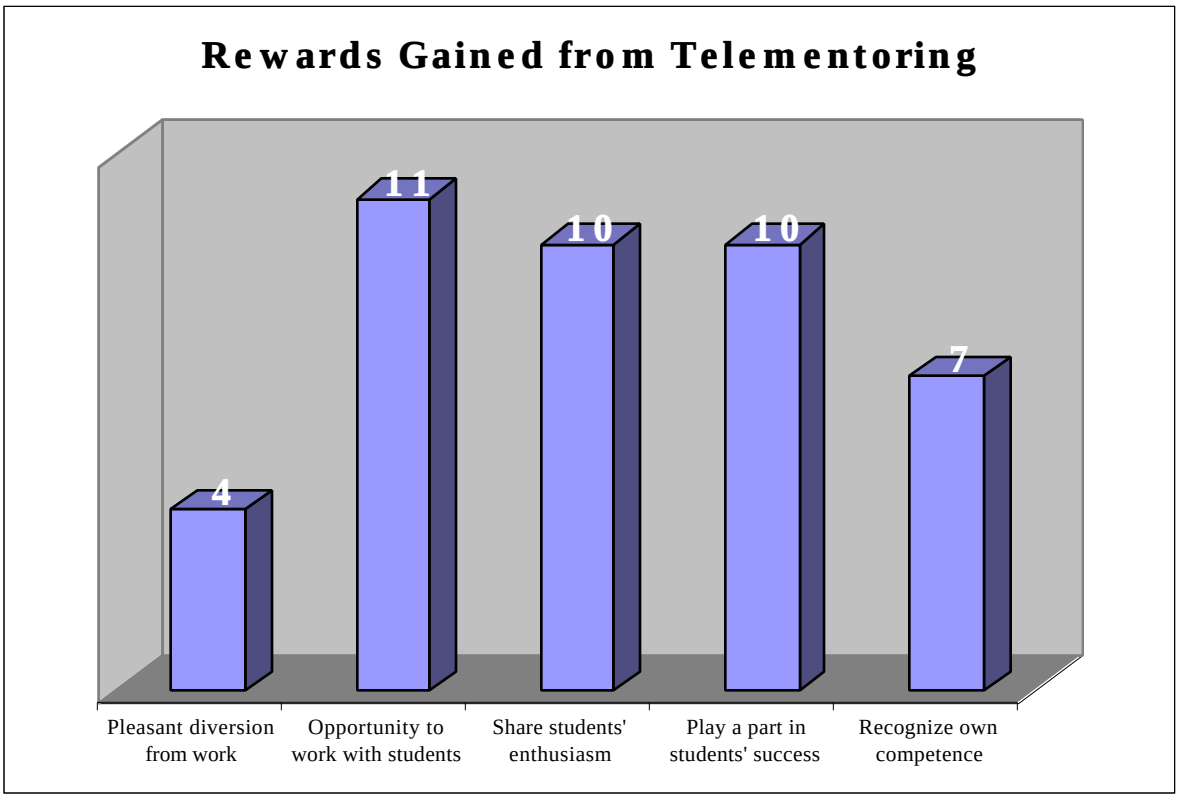
One final constraint on the advice that particular mentees are likely to find useful is their access to various sorts of learning resources (including textbooks, periodicals, reference sources, data archives, and so on). Jack and Eric's desperate search for temperature and ozone data in university libraries across the Chicago area is a vivid example of how important this factor can be; but there are many less extreme instances in which it proves important.

In almost any challenging investigation, students are likely to bump into the limits of the learning resources available close at hand. Most school and city library collections were not built to support deep inquiry in the disciplines, and despite continuous improvement in search engines and digital libraries, the Internet remains a difficult environment for students (and many adults) to find their way around. Sometimes students can find creative ways to escape the limitations of local resources, but often they will need help to do so. While your mentees should not treat you solely as a librarian, you should certainly do your best to help them with information needs that stand in the way of them getting to the pedagogical point of their work (the "mountain" that we discussed in the case of Dan). Often, your expertise will put you in a better position to do this than the classroom teacher.

Because of their deep subject-matter expertise, the majority of our telementors are also well aware that "access" is more than a physical issue. Novice investigators very often try to take on work that is conceptually over their heads, and this presents unique problems. Teachers and telementors must search for ways to help students pursue their curiosities, without carrying out an unconscious parody of whatever discipline they are working in. While students may learn more valuable lessons from struggling with a very difficult question than one that doesn't interest them, they will merely frustrate themselves if they cannot find resources to work with that they can understand.

Dan's experience with the black holes team provides an excellent illustration of this problem, and points to one solution. While originally Dan felt that this phenomenon would not be difficult to understand without complex mathematics, he began to have doubts as the students dug deeper into the problem. Since he had been out of school for so long, he found it difficult to select study resources that students with his mentees' background would find accessible. In the end, he enlisted the aid of co-workers whose judgment he could trust during lunch table conversations. This was a fine strategy that almost any telementor could follow.

The thirteen telementors we introduced you to in Chapter 1 not only helped us to understand why adults take on the role of inquiry telementors, they also revealed to us an array of personal rewards that their work with students helped them to realize. One of the things that separates these rewards from our volunteers' up-front motivations is that they were largely unanticipated. Below, we will discuss the rewards mentioned by our interviewees, using their own words as much as possible. Like the motivations we discussed in Chapter 1, you may find that some of our volunteers' ideas resonate with your own.



A pleasant diversion from paid work

In their interviews, four of our thirteen interviewees commented specifically on how pleasant a diversion telementoring was from the routine of their paid work. This was a surprising finding, given that all four volunteers had what many would consider intellectually demanding, and creative jobs. However, even creative jobs have routine elements which occasionally become overwhelming. Dan Johnson, a Physics Ph.D. student, described how telementoring served as an enjoyable release for him:

> I'd be sitting down coding all day, writing [computer] programs, and I'd be able to take....a half an hour [or] an hour break every couple of days to answer this e-mail. ...The main thing was, it was something that I could use when I needed a break. That's really the way I looked at it.

Simply having a short break from their paid work was not reason enough in itself to get our interviewees involved in telementoring. However, it combined with the other rewards we will discuss below in ways that allowed our volunteers to return to their paid work refreshed, and with a renewed sense of purpose.

Opportunity to work with children and adolescents

The great majority of our interviewees (11/13), mentioned that they found telementoring rewarding because it presented opportunities to work with children and adolescents that their work schedules would not normally accommodate. Perhaps Paula Lowell expressed this best when she said:

> Working with children and high school students...brings back for me the joy of science. Kind of getting down to the simpler level. I just find it really fun to do!

Further insight into the enjoyment that telementors derive from working with students was offered by Marshall Anderson:

> [My mentees] were endearing. It was fun...having little high school e-mail buddies. [And] that was a surprise [for me]. I had never interacted with high school students before.

Again, simply chatting with students was not necessarily rewarding for our volunteers in itself. Rather, as we will see below, their rewards came from the intellectual work and the conversations they pursued with their mentees.

Sharing students' curiosity and enthusiasm

Witnessing and helping to direct students' curiosity and enthusiasm was also mentioned as a reward by a large majority of our interviewees (10/13).

In her interview, for instance, Jodi Borden mentioned the pleasant surprise with which she greeted the ideas of a mentee she assumed had disengaged:

> Yeah, she got really keen. I thought she had sort of fallen off the face of the earth for a while, and then all of a sudden she just kind of got into this groove. It was really neat!

As we mentioned earlier, it is not easy to predict which students will be the most active participants in telementoring relationships, and some volunteers found it particularly rewarding to see enthusiasm bubble up from students whom they had nearly given up hope on.

Playing a part in students' success

At times, novice student researchers can let their enthusiasm get the better of them. This can lead to frustration if they do not have timely guidance from a more experienced researcher or a teacher. A majority of our interviewees (10/13) commented on the satisfaction they drew from guiding students through the refinement of their research agendas, so they were neither biting off more than they could chew, nor trimming a problem down to trivial proportions. Take, for example, Randy Roberts' experience with a team of students in Wagner's class who had chosen to study the woolly mammoth. Randy felt that given their limited resources, they would be better off broadening their agenda:

> I think 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.

On the other side of the coin, Don Stark mentioned his work with a group of students to narrow down an overly broad and ill-defined topic. In the end, it was obvious that his influence had made a difference in the students' work:

> It was neat to see...when they were doing their research and they finally whittled it down [so] they could attack it and say, "OK, well we need this information, this information, [and] this information." ...That was a satisfying part of it for me.

Testing and realizing your own competence

Crafting the types of guidance we have discussed in this section, and in the guidebook as a whole, is clearly an activity that demands a certain amount of expertise. For the majority of our mentors, telementoring was an opportunity for them to realize, in a new way, how far along they had come

in their own development. Seven of our thirteen interviewees expressed particular satisfaction with the ways that telementoring had helped them to realize their own competence as researchers and teachers.

Finally, many of our readers may find it surprising how few interviewees (4/13) mentioned the importance of direct thanks as a reward for their work. While our volunteers certainly wanted to know that they had made a difference for their mentees, most found that the recognition they wanted usually come along the way. Marshall provides a good example:

> 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 that they were quite elated. That was nice feedback.

Conclusion

As volunteer telementors have told us, and as their stories have illustrated, knowledgeable adults outside the teaching profession have a great deal to contribute to the education of youth. They also can gain a great deal from this experience.

In the past, teachers have invited parents and community volunteers into their classrooms from time to time to share their expertise. But even very knowledgeable adults do not have much influence over the subjects that students will study deeply, or the understandings they can construct of these subjects, during such rare visitations. Likewise, there is a limit on what adults can learn and the satisfaction they can gain from such brief encounters with students.

Fortunately, the Internet now makes possible much deeper influences between schools and adult work environments in which learning has a high priority. Busy adults, such as those whose voices we shared with you, can now engage in more frequent and routine partnerships with children and educators than they ever could before. These partnerships challenge volunteers in new ways, offer a new venue for lifelong learning, and provide opportunities for students and teachers to take on challenging, long-term investigations with greater confidence.

The adult volunteers, teachers and students whom we interviewed for this work offered us an intimate view of their experiences together, and what they were able to gain from them. It is our hope that with this knowledge, we will be able to bring similar experiences to many more children and adults in the near future. We hope you will join us.

Further Reading

While a great deal has been written about mentoring relationships, inquiry learning, voluntarism, and other themes discussed in this guidebook, the following publications may be of particular interest to readers wishing to deepen their knowledge of these subjects.

On face-to-face mentoring in academic contexts

Daloz, L. A. (1999). Mentor: Guiding the journey of adult learners. (2nd ed.). San Francisco: Jossey-Bass Publishers.

National Academy of Sciences, National Academy of Engineering, & Institute of Medicine. (1997). Adviser, teacher, role model, friend: On being a mentor to students in science and engineering. Washington, D.C.: National Academy Press.

Shea, G. F. (1997). Mentoring: How to develop successful mentor behaviors. Menlo Park, CA: Crisp Publications, Inc.

On face-to-face mentoring in business settings

Kram, K. E. (1985). Mentoring at work: Developmental relationships in organizational life. New York: University Press of America.

On students learning from inquiry, in science and other fields

Berieter, C., & Scardamalia, M. (1993). Surpassing ourselves: An inquiry into the nature and implications of expertise. La Salle, IL: Open Court.

Polman, J. L. (2000). Guiding science expeditions: The design of a learning environment for project-based science. New York: Teachers College Press.

On voluntarism

Hall, M., Knighton, T., Reed, P., Bussiere, P., McRae, D., & Bowen, P. (1998). Caring Canadians, involved Canadians: Highlights from the 1997 national survey of giving, volunteering and participating (Research Report 71-542-X1E). Ottawa: Statistics Canada.

Hayghe, H. V. (1991, February). Volunteers in the US: Who donates the time? Monthly Labor Review, 17-23.

On telementoring and research surrounding it

Telementoring for knowledge-building web site: http://csile.oise.utoronto.ca/TM-KB/front.html

Electronic Emissary web site: http://www.tapr.org/emissary/

MentorNet web site: http://www.mentornet.net/

International Telementor Center web site: http://www.telementor.org/

Contact

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Little, J. W. (1990). The mentor phenomenon and the social organization of teaching. Review of Research in Education, 16, 297-351.

Neils, D. (1997). The Hewlett-Packard e-mail mentor program. [on-line] http://mentor.external.hp.com/

O'Neill, D. K. (1997, March). Bluffing their way into science: Analyzing students' appropriation of the Research Article genre. Paper presented at the American Educational Research Association, Chicago, IL.

O'Neill, D. K. (1998). Engaging science practice through science practitioners: Design experiments in K-12 telementoring. Unpublished doctoral dissertation, Northwestern University.

O'Neill, D. K. (in press). Enabling constructivist teaching through telementoring. Special Services in the Schools.

O'Neill, D. K., & Gomez, L. M. (1998, November). Sustaining mentoring relationships on-line. Paper presented at the ACM Conference on Computer-Supported Cooperative Work, Seattle, WA.

O'Neill, D. K., Wagner, R., & Gomez, L. M. (1996, November). Online mentors: Experimenting in science class. Educational Leadership, *54*, 39-42.

Scardamalia, M. & Bereiter, C. (1997). Adaptation and understanding: A case for new cultures of schooling. In S. Vosniadou, et al. (eds.), International perspectives on the psychological foundations of technology-based learning environments. Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Tomlin, V. E. (1994). A mentor program for improving the academic attainment of black adolescent males. Unpublished doctoral dissertation, University of Denver.

Waltner, J. C. (1992, March). Learning from scientists at work. Educational Leadership, 48-52.