Mentoring in the open: A strategy for supporting human development in the knowledge society

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Abstract: On-line mentoring, or "telementoring" between K-12 students and adult volunteers has proven a valuable way to enable ambitious classroom inquiry. However, past research has shown that simply placing mentoring opportunities at the disposal of all students is not enough to make telementoring effective on an equitable basis. When mentoring relationships are conducted via private media like e-mail, the students who most need to see models of successful mentoring are, in fact, the least likely to encounter them. In the worst case this leads to a "rich get richer" dynamic, in which only students with previous experience of supportive learning partnerships are able to draw benefit from them. In design experiments conducted in Toronto-area high schools, we orchestrated telementoring relationships in a Knowledge Forum™ database — an asynchronous, electronic group workspace. In this new model of telementoring, students could (and did) "peek" into the telementoring dialogues of their peers. This "opportunistic model-seeking", as we call it, allowed students to develop more sophisticated ideas about the kinds of advice and guidance they wanted from their mentors, defeating the "rich get richer" dynamic. Our findings suggest that mentoring in the open may serve as a powerful component strategy for building equitable and sustainable on-line learning communities for participants of diverse age and expertise.

Keywords: mentoring, learning communities, computer-mediated communication, discourse, diversity, motivation, student beliefs, educational reform

Introduction

> Education being a social process, the school is simply that form of community life in which all those agencies are concentrated that will be most effective in bringing the child to share in the inherited resources of the race, and to use his own powers for social ends. (Dewey, 1897)

Knowledgeable adults working and learning outside the school system have a lot to contribute to the education of our children. This is why, for many years, teachers have invited parents and community volunteers into their classrooms from time to time. Science fair judging, public speaking contests and "career day" are good examples of the involvement that these volunteers typically have in students' learning. These sorts of activities are undoubtedly worthwhile; but during such rare visitations even very knowledgeable adults cannot have much influence over the subjects that students can study deeply, or the understandings they can construct of these subjects. For the most part, brief expert visits reinforce traditional pedagogy that we know fails children on a number of counts (Scardamalia & Bereiter, 1997).

The Internet now makes possible much deeper and more routine influences between schools and adult work environments in which learning has a high priority. The long-term goal of our research is to develop practical strategies and technologies to engage all students in a computer-mediated "knowledge society" (Scardamalia & Bereiter, 1996) that is heterogeneous with regard to both knowledge and age. In this society, children and adults would explore ideas and build knowledge together on a routine basis, across multiple subject areas. This activity would be orchestrated and assessed by professional educators pursuing ambitious constructivist teaching.

The knowledge society would put into practice several tenets of social learning theory which are now generally accepted by learning scientists, including the social situatedness of knowledge (Lave & Wenger, 1991), and learning as apprenticeship (Collins, 1989). In addition, our hoped-for knowledge society would have three features which would strengthen both its potential to support learning and its sustainability:

- *Symmetric knowledge advance*. Children and adults would deepen their knowledge together through shared efforts. In some cases, they might acquire knowledge within the same domain of inquiry; but in other cases children would learn domain concepts while adults would learn more about teaching, their chosen professions, or themselves.

- *The use of diversity as strength*. Rather than taking students' differential experience as a complication in curriculum planning, such differences would be understood as "cultural capital" and leveraged as a resource in the learning of all participants. Not only would students' differential subject-matter knowledge be of value, but also their differential experience with and understanding of relationships that are supportive of learning.

- *More opportunistic social arrangements, fewer masterminded ones*. While a community of practice cannot function without some norms and routines, these should be flexible and improve over time. "Masterminded" arrangements for computer-supported collaborative learning tend to be brittle, with little capacity for adaptation. Ideally, both the technological affordances and social arrangements that sustain the knowledge society would permit adaptation and growth.

In recent work, we have attempted to realize these goals by combining knowledge-building pedagogy (Berieter & Scardamalia, 1993) with telementoring (O'Neill, Wagner & Gomez, 1996). Using data from surveys, interviews, and records of students' reading behaviour in Knowledge Forum™ databases, we will discuss the potential of this socio-technical "learning infrastructure" to alleviate developmental challenges that have been documented in e-mail based telementoring (O'Neill & Gomez, 1998, November).

Telementoring, Knowledge Building, and Human Development

On-line mentoring, or "telementoring" between K-12 students and adult volunteers has proven a valuable way to enable the kind of ambitious inquiry that the knowledge society would revolve around (Harris & Jones, 1999; O'Neill et al., 1996). Like tutors, on-line mentors can reduce the likelihood of floundering during problem solving (Merrill, 1992). In addition, though, they can serve as a responsive audience that holds students accountable to disciplinary standards of thinking and reasoning (O'Neill, 1997, March). In this way, they can play an important role in helping students see themselves as "smart" — a phenomenon that Resnick and Nelson-LeGall refer to as "socializing intelligence" (Resnick & Nelson-LeGall, 1997).

Unfortunately, past research has shown that simply placing mentoring opportunities at the disposal of all students is not enough to make telementoring effective on an equitable basis. O'Neill & Gomez (1998, November) observed that students with little experience of supportive intellectual partnerships may not be equipped to anticipate the benefits that telementoring could have for them. This poverty of experience means that students are sometimes loath to invest much up-front effort in making a telementoring relationship work. This should not surprise us. Because mentoring is, by its very nature, a developmental phenomenon (Kram, 1985), it is natural that one's motivation and ability to participate in mentoring relationships be a function of one's past experience with them — or lack of it.

Take, for example, two high school boys who participated in a private, email-based telementoring relationship in earlier research by the first author (O'Neill, 1998). This relationship proved disappointing to the students, in part because they did not have the experience to manage it effectively. Furthermore, because the boys were unaware of the positive experiences that their own classmates had had with telementoring, they developed a pessimistic outlook toward the entire idea. This attitude was revealed in a focus group with the first author:

> Student A: I say abolish mentoring.
> Student B: Yeah, I think you should abolish mentors [in this class].
> Interviewer: Why?
> Student B: Well, because I don't think anyone's had a good experience.

An unfortunate consequence of carrying out mentoring relationships via e-mail, or other private media, is that those students who most need to see models of successful mentoring relationships are, in fact, the least likely to encounter them. Because students who only have knowledge of fruitless telementoring relationships are unlikely to invest effort in them, a "rich get richer" dynamic is established. Students with previous experience of supportive learning partnerships actively pursue the opportunity to work with telementors, while those with relatively little experience throw the chance away. This problem was observed in earlier research, and labeled "the developmental catch-22" of telementoring (O'Neill & Gomez, 1998, November).

In our hoped-for knowledge society, technical affordances and social participation frameworks would be fashioned so that students could *develop* experience with knowledge-building relationships like telementoring. This is critical, because interview work with students and mentors involved in such relationships suggests that

transferring lessons about mentoring presented as abstract “rules of thumb”, or case studies involving alien contexts and personalities, is difficult for children. If the ideal of the knowledge society is to be attained, less didactic strategies must be found for overcoming the developmental catch-22. Here we discuss one possible solution, which we call “mentoring in the open”.

Research Context

In design experiments conducted in two Toronto-area high schools between 1997 and 1999, we orchestrated telementoring relationships in a Knowledge Forum™ database — an electronic group workspace built especially for communal knowledge-building. The 112 students involved in this research were all of high school age, and were enrolled in general science and biology courses from grades 9 to 11. These students were all of above-average academic performance, but were quite racially mixed, with high percentages of nonwhite students in each class.

Each of the three classes was taught by a different teacher, who was only moderately experienced in using Internet technologies for teaching. Each had used Web Knowledge Forum™ for a single curriculum unit per year in the two years prior to this study, but none of the three teachers would be considered great pedagogical innovators. For the most part, all three classes followed traditional lecture-lab-demo pedagogy. Students' work with Knowledge Forum™ and their telementors took place as part of a 10-week "Independent Study Unit" — a mandated part of the curriculum for these courses in which students traditionally write library research essays on their own time.

In the new model of telementoring tested here, students did not work privately one-on-one with their mentors; nor did they work in isolated teams, as is the norm in other implementations of telementoring. They did collaborate on their research, but each student produced a unique individual synthesis of this shared work at the close of the unit. After declaring their research interests to their teachers, students were organized into thematic “working groups” of varying sizes: from a single student to 10 or more. Initial "matches" were made between each of these working groups and a volunteer mentor with related expertise, who oversaw their work. “Views”, or compartments, were also set up within the Knowledge Forum™ database to help the research groups organize their efforts; but these were more like movable curtains than walls. While each student and mentor had a "home" view in which to place their research notes and communicate with others, these views were open for everyone to read and write in.

Students' access to computers at school was entirely in a central computer lab, though many students also had some form of access to the Internet at home, and used Web Knowledge Forum™ there to work with their mentors and each other. While home Internet access was not made a requirement of participation, 57% of participating students had web access at home in the 1997/98 school year. In 1998/99, 87% did.

Mentoring in the Open: Short-circuiting the Catch-22

Our first experiments with telementoring in a shared electronic workspace were a pleasant surprise. 74% of the 112 students claimed on our survey that Knowledge Forum™ was moderately to very helpful to them in their work. These positive reactions seemed due, in large measure, to the way in which the software and participant structure allowed students to self-monitor their performance relative to others. This “opportunistic model-seeking”, as we call it, allowed students to emulate the best practices they observed among their peers and peers’ mentors. As one student explained in an interview:

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

Our volunteer mentors also engaged in this opportunistic model-seeking, despite the fact that the possibility was not even mentioned to them by the researchers or the teachers. One mentor, a biology specialist from a local science museum, explained how she began to examine other mentors’ advice-giving strategies in order to improve upon, or validate her own:

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

As the data below will show, those students with limited experience of mentoring relationships spontaneously took advantage of the affordances of the Knowledge Forum™ software and the telementoring

participation structure to seek models of behaviour. Our analysis will show that while students were not actively encouraged to do this, or graded on the number of database notes they read, browsing the discourse of their peers and peers' mentors allowed them to develop more sophisticated ideas about the kinds of advice and guidance they wanted from their mentors. This growth was accomplished without either an onerous "training" period, or a set of cookbook routines for interaction that might straight jacket mentor-mentee discourse.

Data, Analysis and Findings

Data for this study consisted of handwritten student surveys (completed at the end of the unit), interviews with a stratified sample of students and mentors, and logged statistics of students' reading behaviour in the Knowledge Forum™ database. Our survey form asked students to reflect on their relationships with their mentors. On one page of the survey, respondents were asked to rate the importance of 10 different "mentoring functions" (types of advice, guidance or help) to the "ideal" telementoring relationship. The 10 mentoring functions listed on the survey were:

- Help me come up with a question/idea to investigate
- Ask me questions to help me think about my research
- Answer questions I have about scientific ideas
- Give me background information on my topic
- Give me locations on the Internet where I can find resources to answer my question
- Help me to understand material I read about my topic
- Suggest challenging things for me to do that will improve my research
- Review my work as I go along and help me stay on track
- Suggest specific strategies that will help me get my work done
- Suggest books/magazines/scientific journals that I should read

In order to boil students' desirability ratings for the 10 mentoring functions down to more usable summary measures, a factor analysis was performed. Results suggested that for our students, the 10 telementoring functions broke down into two natural kinds (see Table 1). Factor 1 was labeled "inquiry jumpstart" because it includes only those kinds of advice, guidance and help that students normally associate with "getting started" on an investigation: background information, pointers to Internet resources, references to reading materials, or ideas about viable project topics or questions. What distinguishes these mentoring functions from those loading on Factor 2 is that none imply an ongoing relationship or accountability between students and their mentors. By contrast, the functions loading on Factor 2 suggest the role of a "prodding partner" who does more than get students started. By asking questions, reviewing students' work, and offering ideas about challenging things that students can do to learn more, the "prodding partner" remains continuously involved in students' learning.

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

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

Ideally, volunteer mentors in the knowledge society would play roles more akin to prodding partners than inquiry jumpstarters, since the hallmark of knowledge-building activity is that over time, adults and children collectively "up the ante" on the problems of understanding they feel themselves accountable to (Berieter & Scardamalia, 1993). This ante-upping implies a degree of mutual responsibility among knowledge-building partners — whether adults or children — to respect each others' contributions and to consider taking them to heart, even when it might be troublesome, or create additional work.

Using the results of the factor analysis, we constructed two "role scales" reflecting each student's desires for mentoring functions of the "inquiry jumpstart" or "prodding partner" varieties. A respondent's score on each role scale is the sum of their desirability ratings for the functions loading on the corresponding factor. The two role scales

are not revealing in themselves, but can be used in combination with other data to test whether our use of the Knowledge Forum™ environment helped to defeat the developmental catch-22. If this were true, we would expect students who read more extensively in the database to have higher scores on the prodding partner scale. Wider reading would presumably expose students to more models of mentor and mentee behaviour, and put them in a better position to appreciate the variety of ways that mentoring relationships can be helpful.

The data seem to bear out this hypothesis. As Table 2 shows, none of the Knowledge Forum™ note reading measures correlate significantly with the desire for inquiry jumpstart functions (e.g. background information, pointers to Internet resources). This suggests that students who were looking for a quick "information fix" to get their research started rarely scoured the database to find it. On the other hand, students who read extensively in the Knowledge Forum™ database were likely to desire the kinds of advice and guidance associated with a prodding partner (e.g. asking useful questions, reviewing work). Correlations were significant between the prodding partner scale and all three database reading measures: reading the notes of one's assigned mentor, of other mentors, and of other students.

Table 2: Correlations between desired mentor role scales, database reading habits, and judgments of overall satisfaction with the mentor relationship (* indicates p<=.05)

	Inquiry Jumpstart	Prodding Partner	Satisfaction
Student Satisfaction	0.078	0.064	1.000
% Notes Read Overall	0.122	0.320*	-0.227*
% Own Mentor's Read	0.022	0.294*	0.005
% Other Mentors' Read	0.186	0.269*	-0.232*

While students' judgments of the success of their assigned mentor relationships were not significantly related to the number of their *own* mentors' notes that they had read, both reading other mentors' notes and reading a high number of notes overall were *negatively* related to students' overall judgments of the success of their relationships with their assigned mentors. Interviews and observations suggest that the causality involved actually moved in two directions. Some students, who felt that their assigned mentor relationships were not proving helpful, decided to look elsewhere in the database for models of mentor and mentee behaviour that might improve these relationships. Other students, who thought their relationships were going as well as could be expected, learned from casual browsing of the database that they in fact had room for improvement.

Discussion

These data show that students who opportunistically observed the mentor relationships of their classmates became "choosier" about what they wanted from telementoring. Whether they were prompted to seek models of good mentor and mentee behaviour by relationships they perceived to be in trouble, or changed their ideas about what "success" meant as a result of casually browsing the database, it seems that the combination of technological affordances and social routines that we used in these design experiments helped to short-circuit the developmental catch-22.

The Roots of Opportunistic Model-seeking

These results are certainly encouraging for those, like us, who feel it is important for the knowledge society to support equitable engagement. But some may wonder whether our findings in three high school classrooms are likely to be reproducible in other settings. Perhaps the opportunistic model-seeking that we observed was driven by curiosities that were unique to our participating students. Students with lesser curiosity about telementoring might respond to "mentoring in the open" quite differently.

Fortunately, our students' model-seeking does not appear to have been driven by unusual curiosities. Interview data suggest that in fact, most of our students did not begin their explorations of the Knowledge Forum database with the intention of learning more about telementoring relationships at all. Most students who read notes outside their "home" views appear initially to have been "checking up" on their friends:

> Student C: I went to [another Knowledge Forum database view] and I read some of my friends' notes, just to see how long they were, see what they were writing. I don't know why, but just see what they were doing...
> Interviewer: Okay. So, what do you think you learned from the stuff you read in the other views?

Student C: I think I just...wanted to see what the students were doing in the other view. A view totally different from ours. Just to see what their conversations were like, and how different from ours.

As the quotation above illustrates, students often had difficulty articulating what they learned from observing the mentoring relationships of their peers. Occasionally, however, a student was aware of having directly transferred a lesson from another student's mentoring relationship. Below, for example, a young man studying the science of cloning explains how observing a friend's mentor relationship led him to a breakthrough with his own mentor. His friend had taken a risk by probing his mentor about a confrontational issue related to his research:

Student D: I saw how they related to their mentor, and how they talked. And all I could really do was compare how *we* did with that. It didn't really apply to the final report or anything. I went to the Anti-aging [view], and my friend there was telling me about how, opposing calmness is a good idea. So in my own view I asked my mentor what his views on cloning are...and I stated my own views. Then, he stated his views. That was pretty helpful. I found out what his bias was. He was against human cloning instead of for it. I thought he would be for it, because he was all into cloning and stuff [in his research], right? But it turns out that he was *against* human cloning, [while] he was *for* animal cloning. He said that, you know, there are more benefits from animal cloning. And after reading all these possible bad things that could happen with human cloning, it turned out that I was also for the same view.

Both this and the previous quotation show how students' native curiosities about their peers served as a natural starting place for the opportunistic model-seeking whose effects we documented above. It was not, however, the only starting place. On other occasions, students appear to have perused the database for the explicit purpose of comparing the performance of the telementors:

Student E: [Looking in other views] gives you a lot of information that you may not know. Like, just reading how their mentor was helping them. It was interesting to see how the different mentors acted and how often they responded.

As one might expect, such direct comparisons were not flattering to every mentor:

Student F: Yeah, [I read some other views] out of curiosity, to see how their mentors were doing, how many of them had written back, checked out their final papers.
Interviewer: OK. What did you get out of that?
Student F: Well some of them, the mentors were never there. My friend? [His mentor was] never there. I felt more fortunate, because mine was always there and she helped me a lot more.

Naturally, students on the "losing" end of such comparisons did not feel so fortunate. This was a source of some discontent for students, but the publicity of the mentoring dialogues actually appeared to soften this discontent in an indirect way. In classrooms where e-mail telementoring takes place, students can and do swap stories about whose mentors have offered the most generous support; but they rarely talk about the dialogue leading up to this support. In our new model of telementoring, students could conveniently see not only what advice and assistance other mentors offered their mentees, but how much effort the mentees themselves had invested to make their mentors' contributions possible. In particular, they could see how hard their peers had worked to provide mentors with high "visibility" — clear and thorough descriptions of the work they had been doing, where it was headed, and what challenges it presented. This sort of visibility is an important determinant in the success of telementoring relationships (O'Neill & Gomez, 1998, November).

The inevitable inconsistency in both volunteers' capability and willingness to serve as reliable inquiry partners for students is a key design problem in telementoring, for which there is no easy solution. Private telementoring arrangements provide greater short-term harmony in the classroom by concealing this inconsistency from students; but by the same token, they aggravate the developmental catch-22 and feed the rich-get-richer dynamic. In our more public model of telementoring, students were sometimes unhappy to discover that their peers' mentor relationships were working out better than their own; but unlike participants in private telementoring arrangements, they were always aware that successful relationships were possible, and could find examples of them ready to hand. With this knowledge, they were better equipped to improve the relationships they found themselves

in. Furthermore, we believe that they are more likely to invest effort to developing a telementoring relationship the next time they get the chance.

Model-seeking as an Adaptive Learning Behaviour

Fullan (1999) reminds us that learning and adaptive behaviour emerge from systems which are "poised on the creative edge of chaos":

> ...when systems of any kind...are poised on the edge of chaos between too much structure and too little structure, they 'self-organize' to produce complex adaptive behaviour. If there were more structure, then these systems would be too rigid to move. If there were less structure, then they would fly apart chaotically (Brown and Eisenhardt, 1998, quoted in Fullan, 1999) .

In our public model of telementoring, students' model-seeking was an adaptive behaviour that appeared to be driven by two factors. First, both the potential and the imperfections of the learning infrastructure (Knowledge Forum plus telementoring) were visible to those working within it. Second, the learning infrastructure relied on a well understood, but not rigid social protocol that gave students the resources to act in the interest of their own learning. We will explain both of these ideas further.

It is normal for students to think that the school environment around them has flaws. For example, two friends in the same grade at the same high school may believe that one is being taught Chemistry by a "better" teacher than the other. However, under normal circumstances, students can do little either to verify or address these concerns. In contrast, the affordances of Knowledge Forum™ and the telementoring participation structure together gave our students and mentors a limited ability to improve how the learning infrastructure worked for them. They could seek out models for their own behaviour when and where they were motivated to do so, and could use these models to improve their situations without the burden of advance planning or special permission. The technical affordances of Knowledge Forum made this *possible* and *convenient*, while the flexible social protocol of mentoring in the open made it *acceptable* and *adaptive*.

As the quotations above show, the utility of model-seeking as a learning behaviour seemed apparent to the students we worked with. This seemed to be the case for several reasons. When students "peeked" into areas of the database outside their "home" views, they knew how to interpret the activity they found there, and how to map it onto their own experience. Each view in the Knowledge Forum database contained one mentor, who was easy to spot; and each view contained several students who were working on and seeking advice about problems of understanding analogous to those being worked on in other views. Thus, students could easily anticipate transferring what they learned from their peers' mentor relationships to their own.

The Importance of Human Development in Equitable and Sustainable On-line Learning Communities

As learning scientists move closer to building large-scale, electronically-mediated learning communities, they must concern themselves with the ways in which developmental issues will shape the motivation and ability of both children and adults to participate fully and equally in them. This will be important both for reasons of equity and of social sustainability.

As we explained above, developmental issues and issues of equity are inextricably connected. Simple access, even if it is access to supportive learning partnerships, is not sufficient to ensure full and equal participation by all students, because many students do not enter the school environment with the base of experience they need to take advantage of such partnerships. As more of students' K-12 learning experiences take place on-line, we must seize the opportunity not merely to mirror the developmental affordances of today's schools, but to improve upon them in every possible way. "Mentoring in the open" is not a general solution to this problem; but we believe it can serve as a powerful component strategy in making the future knowledge society as inclusive as it must be.

With regard to sustainability, researchers in the field of computer-supported collaborative learning should be aware that "masterminded" arrangements for curriculum-focused virtual learning communities are brittle. If these communities do not have the capacity to develop from within, as their participants develop, they can only be torn down and rebuilt when their weaknesses begin to show. We see mentoring in the open as one example of a flexible learning infrastructure that can help on-line learning communities to develop and renew themselves over time. In this way, it may contribute to sustainable participation in the coming knowledge society.

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