Three Electronic Networks: Three Kinds of Computer-Mediated Communication

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Abstract: School restructuring calls for change without tools. This paper describes innovative tools for professional development that use computer networking to establish communities of teacher scholars. The networks reviewed include the ATLAS Communities network, Kids Network, and LabNet. The paper describes how these networks operate, in what ways they deploy different kinds of communication devices, and what the researchers have learned about teacher change in these settings.

Professional development for teachers is at a crossroads. In the current calls for school restructuring, we have given teachers mandates without tools. One of the important missing links is a correspondence between existing designs for professional development and what teachers now need so they can deepen their subject-matter knowledge, experiment with pedagogy, alter the assessment practices—all changes central to reform efforts (Little, 1993). Telecommunications offers new possibilities for teachers to expand the horizons of their knowledge and practice. The question, however, remains, How do we use this medium to offer teachers the same cutting-edge design in professional development as that advocated by calls for school reform?

There is no question that teaching is an isolated and isolating profession. No profession can be transformed without the concerted effort of the professionals who examine their practice, create new visions, and invoke changes in practice. Such collective vision, however, can occur only when teachers have meaningful and useful venues for substantive dialogue and the time to engage in such dialogue. Isolation as a defining dimension of the profession points to both the promise and potential challenges we face in using telecommunications effectively.

Computer mediated communication (CMC) has the potential to alter the isolated conditions of teaching and provide teachers with colleagues—both within and beyond the confines of their school district—with whom they can share the experiences of their own practice and their students' learning. Because teachers work in isolation, however, they often lack the experiences, skills, and frame of reference to come together and share the intimate work they pursue in their classrooms. Thus, CMC will not assist in transforming the teaching profession unless we understand how teachers use the medium.

During the past several years we have watched how teachers develop electronic communities of practice. Our research with three different electronic networks indicates some factors that allow CMC to supersede the status quo of teaching. It also suggests the ways in which existing norms of the profession hamper the development of electronic networks for professional development. What we have discovered through our analysis of network conversations is that

there are many variations in how networks are used. Specifically, our research findings suggest:

- There are many different ways that teachers use electronic networks, including resource exchange, collaborative projects, courses, seminars, discussions of hot topics, data exchange, and structured and facilitated conversations.

- In as much as the articulated intentions and purposes of networks differ, so do the ways that teachers use them.

- Network discourse can be facilitated in many different ways, but facilitators or moderators are key in pursuing new ideas about teaching.

- Cultural norms and rules—both explicit and implicit—evolve through CMC. Understanding how these norms and rules govern network discourse is essential to understand how learning occurs through CMC.

- Grounding discourse in practice is key if substantive conversations are to occur that influence teachers' knowledge and practice.

To illustrate both the findings and the questions that have arisen during the course of our research, we present three cases of electronic communities developed for distinctly different purposes. Through these cases, we show how these purposes led to different kinds of discourse and self-designed communities. Following these cases, we present our assessment of the current status of networks for professional development and the directions we consider important for future research.

During the past eight years, we have developed and studied electronic networks for teachers' professional development. Three of these illustrate how the initial purposes and designs of a network generate particular norms and rules that guide how teachers use these networks. The intentions and uses of each of these networks differ dramatically. The Collaborative Assessment Conference focuses the conversation on specific pieces of student work. KidsNetwork relies on the sharing of data from science projects with a common time-table and curriculum activities. Resource exchange, whereby teachers exchange ideas about teaching projects is by far the most typical way that teachers use LabNet, although there are many examples of seminars on LabNet.

On the Collaborative Assessment Conference, we found that conversational rules—agreed upon by all participants—and the formation of a small private group were essential if teachers were to engage in seminar discussions about student work. KidsNetwork, designed for the sharing of data among classes working on the same collaborative science projects, lured teachers into conversations about their practice through conversations their students had on the network. LabNet demonstrates how a network with specific intentions, left unstructured, can lead to interesting and provocative conversations that do not necessarily influence discipline knowledge or practice. What follows are brief cases that highlight some of the unanticipated things that happened on each network that we believe provide insights into the conditions under which CMC can support innovative designs for professional development.

Case One: The Collaborative Assessment Conference

The Collaborative Assessment Conference (CAC) is CMC at its most structured with teachers using a carefully-facilitated forum to discuss student work for portfolio assessment. The CAC format has been used successfully in face-to-face meetings and in a recent experiment at Project

Zero the same conversational structure was implemented using telecommunications. This case reports the structure of the conversation, summarizes the lessons learned, and suggests that conversations of this sort can be used to enhance the diagnostic skill of teachers.

In our research at Project Zero on effective practices with portfolio assessment, we found that an important element of assessment was the thoughtful review of student work. Our research showed that the skills necessary for a careful reading and analyzing of portfolio materials are even more important than developing scoring rubrics. However, we also found that teachers are not typically skilled in this careful reading; when asked to review student portfolios in small groups, their natural tendency is to judge the work, to give it a grade, or to compare it to the work of other students. Careful reading, in contrast, must postpone such judgments in service of careful observation with probing questions.

To address this issue, we developed a structured conversation format called the Collaborative Assessment Conference in which teachers in small groups review a single piece of student work. One teacher selects a piece of work for review; a second teacher facilitates the discussion; three other teachers, who do not work directly with the student, review that work. At the beginning of the conversation, everyone carefully examines the piece, taking as much time as they need. Next, the three reviewers offer their comments: they describe exactly what they see; they select one thing they find most striking; and they develop questions the piece raises for them. Then the presenting teacher is allowed to comment—for the first time—offering additional information about the student and the piece and reacting to the comments of the reviewers. Finally, the facilitator asks all participants to suggest next steps for the student or ideas about how to respond to the work, drawing the conference to a close.

Recently, we conducted an experiment in order to discover whether telecommunications could simulate the face-to-face meeting using the FirstClass bulletin board system. Teachers from three states who had never met participated and a researcher at Project Zero served as the facilitator. A high school teacher volunteered to present a piece of student work. She selected a biography assignment in which her students developed a two-page sketch of a family member and posted the piece in the "CAC" folder on the bulletin board. The three reviewing teachers read the piece and posted their responses in the same folder. Following the CAC format, they talked about what they noticed, what was most remarkable, and questions the piece raised for them. Then the presenting teacher wrote her reactions.

We learned two lessons from this first electronic conversation. Because all the messages were posted publicly, other members of CAC followed the conversation and several even began to participate. Second, the electronic conversations were more slowly paced than we had expected. The entire process took nearly a month, even though the participants were diligent in reading and responding to one another. This slowness of response was often interpreted by the participants as a lack of interest by others. At worst, they saw it as a subtle form of criticism. Several teachers admitted privately that they felt that if their ideas had been more interesting, others would have responded more promptly.

We addressed the teachers' concerns during a second month-long e-CAC session. First, to give the conversation a sense of privacy, we used the private e-mail feature of the network, addressing messages to the participants rather than to a public folder. Second, the facilitator proposed a quick-response rule—all participants pledged to log onto the system once a day and to respond immediately to all messages. If they did not have time to write a detailed answer, they would wrote a short acknowledgment and provide more detail later. These adjustments gave the second CAC more of a feeling of a small group discussion; thus, teachers and facilitators thought the second e-CAC was generally thought to have been more successful.

From this experience, we learned that the CAC format can indeed be implemented with telecommunications, but like the face-to-face version it requires careful facilitation of the rules of conversation. Also, those rules must be adjusted somewhat to accommodate the particular requirements of the electronic mail system. Finally, in both CAC experiments, the teachers engaged in rich and rewarding discussions about student work, bringing their often isolated classroom practice into a collaborative setting. They became more adept at making thoughtful reviews of their students' work. By drawing teachers together in a conversation about a sensitive and substantive issue like classroom assessment, the electronic CAC serves as an important demonstration of professional development at a distance.

Case Two: KidsNetwork: A Data Exchange Network

The NGS KidsNetwork is an activity-based network that connects students, classes and teachers in a collaborative learning and teaching environment. Students use the network to share data from common experiments; they debate topics of social concern that are related to these experiments; and they exchange ideas for further research projects. Although the exchange of data is carefully timed, the conversations are more loosely structured than the CAC. This case describes several of those conversations, in which students debate the interpretation of data and teachers share pedagogical experiences. Although the teacher conversations become the central focus for this report, the expectations for the data exchange network in general, and the student exchange in particular provide the basic scaffolding material.

Explicit expectations concerning form and content of class data exchanges are articulated in the NGS KidsNetwork Teachers' Manual, but individual students and teachers communicate with each other. We have observed two characteristics of the Data Exchange Network that appear to foster important communication between individuals on the network.

A clear focus gives rise to the need for clarification which has important intellectual benefits for students. Using CMC to resolve their dilemmas with one another gives teachers new insights into how students grapple with conceptual dilemmas.

Since the KidsNetwork curriculum requires precise and accurate data for its implementation, sharing attitudinal or belief data that is typical but doesn't represent individual differences serves to prompt individual participation. As part of a field test of the NGS Kids Network unit, *How Does Your Body Get the Oxygen It Needs?*, classes are asked to share the results of a vote taken in their classroom about whether smoking should be banned in public places. When one class emerges as an outlier—they alone vote NOT to ban—individual students of the majority or minority opinion in that class express their reasoning on the network and students from other classes respond. Jennifer wrote that she disagreed with the majority of her class and said "it was a scary thought to find out that I get 2 cigarettes without even smoking." And Danielle responded that she agreed with the majority of her class and said "If someone in a mall is smoking and you don't want to smell or breathe the air, you could just walk around that particular person."

The questioning of anomalous data revealed students as scientists—debating data with peers. A high mean vital capacity reported by another class prompted Brian to write that his class discussed the outlier and assumed it wasn't caused by inaccurate information given the care with which his own class took their information. So they asked the school in Madison, Wisconsin to explain. The class from Madison replied that they realized they were an outlier, rechecked their calculations and found their numbers were an order of magnitude off because

"What goofed us up was all the tick stuff. We used 1000 ml. beakers and really didn't need the ticks."

These focused debates between students and their peers in other classes provide teachers with an important window on student understanding

Groundedness in the curriculum and classroom context gives rise to intellectual musings about teaching and learning among the teachers.

As the Data Exchange Network is grounded heavily in the classroom context, discussion of implementation issues is the explicit expectation. Such implementation sharing leads to discussions on a different level of analysis. During a single week five teachers engaged in a conversation which evolved from "whether to teach glycolysis" to "what our job as science teachers is". Grounding the exchange in science content with which all participants were currently grappling gave them a chance to introduce elements of their own practice as they reflected upon the problem.

Tom's class had just completed an activity in the curriculum designed to further kids' understanding of the carbon dioxide/oxygen exchange when he posted this message on the forum:

> I am curious as to how anyone deals with the common misconception among students that the oxygen that they breathe in comes back out as carbon dioxide, when in fact the oxygen they inhale is converted to water during glycolosis. The carbon dioxide is released from the break-up of glucose.

Virginia turns the conversation into a more substantive one about depth of science understanding by asking "what do we teach at what time to what depth???" leading Bob to frame the dilemma as "The problem with teaching science is that there is too much out there, all of it is important and there isn't enough time to teach it all".

Gary picks up this theme without reference to the original glycolysis question by suggesting that "Perhaps our job isn't as much to solely instruct but to foster that innate curiosity to encourage them to raise questions, and show them that wondering should be as highly valued as knowing".

It is our hunch that the tension between the requisite precision, accuracy and fixed time-table of expectations for this data exchange network and the groundedness of the curriculum context provides the correct mix and balance for growing discussions about teaching and learning.

One of the other things we observed was how the interest among students sparked interesting conversations among the teachers. It was almost as if the teachers had the chance to look over their students' shoulders as they worked together to sort out their ideas. Watching their students solve problems through CMC allowed teachers—perhaps for the first time,—to step out of their roles as guide, lecturers, and facilitators and merely observe learning. We suspect that the "freeing-up" that CMC affords teachers could enhance their diagnostic skills in similar ways to the CAC approach.

Case Three: The LabNet Network

LabNet was developed to promote project-based science teaching by creating a forum so that teachers could reflect on the teaching and learning that occurred as students worked on projects (Roupp, Gal, Pfister, and Gal, 1992). As the modus operandi for developing LabNet, the

staff encouraged and supported teachers in defining the network for themselves. Thus, the rules and norms of the network evolved through its use by middle and high school science teachers (Jacobs and DiMauro, 1994). This case describes the rules and norms of one particular genre that emerged, the "hot topic," or discussion about a controversial issue. The case concludes that conversations about hot topics follow a different set of rules but participating in these conversations may enable teachers to take risks in entering discourse about pedagogy.

A random sample of over 10,000 archived messages indicates that 89% of the LabNet messages were of the "how-to" variety. The other 11% were interesting experiments in creating forums that promoted discourse about teaching projects, knowledge, philosophy and methods of science (Muscella and Kopicko, 1995). The prevalent number of folders focused on craft knowledge, which is a typical response to experimenting with new pedagogy because teachers were seeking practical knowledge about teaching science (Fullan, 1991; Hall and Hord, 1987). Other LabNet folders were an attempt to grapple with the issues of teaching science in an innovative way. The problem was that none of LabNet conversations were grounded in a common practice or a common task as the CAC or KidsNetwork conversations had been. As a result, the conversations about craft were brief and to-the-point and the conversations about philosophy, knowledge, and methods of science began and remained ungrounded in practice; hence, the conversations lacked purpose and focus. At the same time, because a hot topic like *Creationism* considered particular philosophical or science issues, the discourse was forceful, opinionated, and sometimes vitriolic. Although few in number, these folders shared two characteristics which we believe important in supporting teachers to experiment in their practice. We describe these excerpts from the *Creationism* conversation.

Few messages argued from extant research and when either side brought up legitimate questions that might have grounded the conversation in the theory of science, the questions were ignored and never addressed in he conversation.

In early December, Gary, who acknowledged his belief in creationist science, tells why he has difficulty with the theory of evolution. He writes:

> ....I have never been satisfied by any explanations...about the missing transition forms between species from the fossil record. This was a problem for Darwin, too, and he hoped that they would surface in the years following his proposal for natural selection as a driving force for trends towards complexity. To my knowledge the few transition forms that are...offered as examples are severely debated between the evolutionists themselves...

Two messages later in the folder, Ted, a physicist who supports the theory of evolution, asks the biologists in the folder to address some of the issues that Gary has raised. In short, Ted asks others to address issues Gary raises with scientific information.

> I believe you (Gary) raise some very interesting questions about the lack of confidence many scientists have in biological evolution theories. I regret that I don't have much of a biology background to refute each issue raised...Perhaps some biologist will enlighten the rest of us non-biological scientists with and issue-by-issue argument against your objections.

Craig posts some quotes from Stephen Jay Gould, a noted Harvard evolutionary biologist. Yet, the quotes he uses are Gould at his most philosophical and he does not quote Gould's simple prose that explains evolution eloquently. No others address either Gary's issues on Ted's request for explanations. Gary's proposition about evolutionary theory and Ted's entreaty for a debate grounded in theory remain unheeded in the folder.

There was conflict between the norms by which LabNet usually operated and responses used during hot topic conversations.

One of the overarching and explicit rules that guided LabNet was supporting participants, that is, teacher moderators and most teachers avoided disagreement that would make others feel uncomfortable. Thus, when a teacher raised a point of disagreement during a seminar discussion about science or pedagogy, the message was typically: 1) ignored, 2) supported indirectly, or 3) addressed obliquely by raising philosophical questions to circumvent overt disagreement (Muscella and DiMauro, 1995; Muscella and Kopicko, 1995).

In the *Creationism* folder, however, it was difficult to maintain the norm of supporting participants. The following messages from Andrew and Colleen underscore how teachers' sensibilities about science superseded this particular LabNet norm. Andrew writes first and Colleen follows. Colleen writes:

> Creationism is not a science. It offers no rational explanation for the natural wonder of the world. Instead it relies on an appeal to faith....Nor will I accept the term science as part of its definition, for by its nature, it has shown itself to reject limitations that science sets for itself.

Craig responds with a message intellectually sympathetic to Colleen's.

> Science is a discipline, not a religion. We deal in facts and observation, hypotheses and theories, and paradigms, which we are continually evolving to accommodate new evidence. It is a dynamic process. We are constantly engaged in trying to poke holes in the popular theories of the day in an effort to arrive at a better approximation of why things are the way they are.....

Although the *Creationism* folder seems an exaggeration of day seminar discussions on LabNet, because the teaching of evolution theory has been controversial, both historically and currently, teachers have strong opinions about it. Thus, the folders' emotional character and level of participation were more accelerated than other conversations. We suspect that both the hot topics and seminar discussions were attempts to ground conversations in the knowledge and pedagogy of teaching projects. Perhaps if the staff or moderators had suggested reading a Stephen Jay Gould chapter and then discussing evolution, the folder might have allowed teachers to deepen their own knowledge of science. Or maybe, if teachers had considered how to use empirical science in presenting evolution theory to their students who believe in creationist science, the conversation would have become grounded in practice. We remain convinced that the hot topic platform offers a way to expand teachers' ability to engage in intellectual debate about pedagogy and science.

Conclusions and Questions to Pursue

Can we bring about a renaissance in designs for professional development? If so, what would such designs look like when enacted? Recently, educators and researchers have proposed new ways to pursue professional development for teachers (Lieberman, 1995; Little, 1993; Little and McLaughlin, 1992). Little (1993) proposes the conditions and parameters for such a vision. She imagines that any professional development endeavor will offer teachers "meaningful intellectual, social and emotional engagement with ideas, with materials, and with colleagues both in and out of teaching (p. 138)." She also argues, among other things, that professional development must take "explicit account of the contexts of teaching and the experience of teachers (p. 138)."

Electronic networks offer one venue for both of these propositions, but as their CMC characteristics vary so do their functions and respective strengths. One of the important challenges we faced in these three networks was finding ways for teachers to share their classroom and school context electronically, crucial if electronic discourse is to impact practice. How can we use the medium to help teachers provide rich descriptions of the teaching and learning that takes place in their classrooms? What other sorts of technologies would best provide the needed "texture" to what might be seen as a bare-bones verbal medium? Perhaps something as simple as a few photos of students working on projects, scanned into an electronic folder, would spark a more detailed discussion about what and how students learn.

Our research also suggests that the cultural norms of teaching filter into the CMC world. And, the medium itself gives rise to norms that are both explicit and implicit. From our work we suspect that cultural rules and norms on networks greatly influence the kind of professional development activities that become possible electronically. Without knowing more about how the interactions between norms and network participation, it will be difficult to exploit CMC to its fullest potential for teachers.

Finally, we need to explore how to reap the benefits of the network and help teachers to bring the knowledge back home to their schools. There is the danger that teachers will develop cyberspace communities and yet continue to work behind closed doors, perpetuating the profession's isolation. If CMC is to become a useful tool for professional development, then we must give careful consideration to the relationship between electronic and school communities. We argue that the careful study of district-wide reform efforts linked to CMC professional development is essential if electronic networks are to support school restructuring.

References

DiMauro, V. & Gal, S. (1993). *Socio-technical factors of telecommunications for promoting reflective dialogue.* National Association of Research on Science Teaching, Annual Meeting, Atlanta, GA.

Fullan, M. (1991). *The new meaning of educational change.* New York: Teachers College Press.

Jacobs, G. & DiMauro, V., (1994). *LabNet Survey 1994.* Working Paper, TERC: Cambridge, MA.

Hall, G. and Hord, S. (1987) *Change in Schools: Facilitating the Process.* Albany: The State University of New York Press.

Lieberman, A. (1995) Practices that support teacher development. Phi Delta Kappan, Vol 76, #8, pp 591-6, April.

Little, J. W. (1993). Teachers' Professional Development in a Climate of Educational Reform, *Educational Evaluation and Policy Analysis,* vol. 15, No. 2, 129-151.

McLaughlin, M. W. (1990). The Rand Change Agent Study: Macro perspectives and Micro realities. *Educational Researcher.* 19, 11-16.

McLaughlin, M. W. and Little, J. W. (Eds.) (1993). *Teachers Work: Individual, colleagues, and contexts.* New York, Teachers College Press.

Muscella, D. and DiMauro, V. M. (1995). Talking about Science: The case of an electronic conversation. *Journal of Technology and Teacher Education.*

Muscella, D. and Kopicko, R. (1995). *Electronic Networks: Problems or Promises.* Paper presented at the annual meeting of the American Educational Research Association, San Francisco.

Ruopp, R., Gal, S., Drayton, B., & Pfister, M. (Eds.)., (1993). *LabNet: Towards a community of practice.* Lawrence Erlbaum: New York.