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ABSTRACT

The Mathematics Learning Forums, a collaborative effort of Bank Street College and the Center for Children and Technology, Education Development Center, Inc., provided the primary research setting for this study. Each 8-week forum focuses on specific elements of a mathematics content area and is designed to address both student learning and teaching strategies. Participants are required to have an Internet account and are expected to participate at least twice weekly in online discussions. The forums provided the opportunity for an in-depth contextualized understanding of the experiences of 35 teachers involved in three 8-week online courses. The research design used a combination of data gathering tools including questionnaires (n=31), exit interviews (n=30), and content analysis of all public online exchanges (n=393). Six variables framed the professional interaction items: (1) teacher work group cooperation; (2) opportunities to exchange new ideas and instruction; (3) opportunities for reflection about practice; (4) capacity to give and receive feedback; (5) structures and norms that encourage a problem-solving approach to teaching; and (6) role of principal. Generally, the results showed that computer-based network professional development is far from reaching its potential. Many, but not all, of the remaining problems were technical issues. Teachers inflexibility and lack of familiarity with new technology were also obstacles to an online professional development program. (Contains 24 references.) (JLS)

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From Isolation to Interaction? Network-Based Professional Development and Teacher Professional Communication

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TO THE EDUCATIONAL RESOURCES
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Introduction

Many teachers who use telecommunications technology in their classroom report that it stimulates learning and redefines the role of both student and teacher (OTA, 1995). But the potential educational benefit of telecommunications—computer-to-computer communication via telephone lines—extends beyond its direct use with students. Telecommunications is also heralded for its potential to facilitate the professional growth of teachers. Proponents of network-based professional development claim that it offers a viable solution to the challenge of providing large numbers of teachers the support they need to develop content expertise and to put new instructional strategies into practice.

To meet rising expectations for students, teachers are being asked to deepen their content knowledge, learn new methods of teaching, and integrate new technologies into classroom practice. In order to change practice, teachers need opportunities to revise their understanding of what it means to know, to learn, and to teach. Conventional approaches to teacher professional development, however, are inadequate. Mandatory in-service days often rely on one-shot lecture-style formats that transmit knowledge and skills rather than creating experiences where teachers construct new understandings in ways that model new ways of teaching. In addition, teachers find it difficult to apply what they have learned without on-going support during implementation. Yet, because of expense and the difficulty of finding common time, follow-up of any kind is unusual.

Network-based professional development is being heralded as a viable supplement to face-to-face professional development. Many barriers, such as the expense of bringing groups of teachers together, scheduling constraints, and the difficulty of sustaining reflection about practice beyond the conclusion of short-term workshops, can be overcome with telecommunications. The asynchronous nature of communication in this medium can accommodate teachers' highly scheduled working lives and has shown promise in supporting the development of content expertise and in facilitating reflection about practice (Honey & Henríquez, 1993; Merseth, 1992; Ruopp et al., 1993).

As the opportunities for teachers to become involved in network-based models of professional development increase, interest in better understanding how to make these experiences most effective for participants also increases. Too often the promise associated with innovations reflects more about proponents' hopes than about users' actual experiences. While an overarching goal of many on-line initiatives is to encourage professional relationships between teachers that support reflective conversations and improved practice, not enough is known about what enhances or gets in the way of these relationships. For network-based professional development to be a viable option, the conditions that challenge and enhance effective participation need to be understood—from the users' perspective. This study examines the experience of teachers involved in network-based professional development and the factors that influenced their on-line participation. The key questions were: 1) What was the nature of on-line activity? 2) What factors relate to participation? and 3) How does NBPD supplement and influence existing professional interactions and growth?

Research Setting

The Mathematics Learning Forums (Forums) provided the primary research setting for this study. The Forums are a collaborative effort of Bank Street College and the Center for Children and Technology, Education Development Center, Inc. (EDC). The project is "designed to provide teachers across the country with on-line professional development experiences that support them in implementing aspects of the NCTM Standards in their classrooms" (Honey et al., 1994, p. 163). The Forums' approach relies on small group interaction supported by on-line communication in conjunction with print and video resources. Communication occurs via listservs. Teacher-students are connected with a faculty advisor as well as with a small group of peers who all share their experiences. The process is designed to encourage teacher-students to "develop personal knowledge that is connected to their educational practice and to issues in educational research and reform" (Honey et al., 1994, p. 164-5). That is, the Forums are designed to focus on integrating educational theory with reflective practice.

Each eight-week Forum focuses on specific elements of a mathematical content area and is designed to address both student learning and teaching strategies. The designers explain, "Each forum begins with the introduction of mathematical ideas, described and illustrated through print and video, and then moves into activities that teachers implement in their own classrooms. Graduate faculty, serving as on-line advisors, guide teacher-students as they try out new activities and techniques in their classes and reflect on the meaning of those experiences" (Honey et al., 1994, p. 163-4). The cost of enrollment at the time of the study was \$450 for one graduate credit, \$200 for inservice credit, and \$180 for personal enrichment. Participants needed to have an Internet account and were asked to be teaching math in a classroom for the duration of the Forums. Participants were expected to log on at least twice a week to contribute to on-line discussions.

Three Forums conducted in the spring of 1996 provided data for this study. The respondents were more likely to be female and younger than the average teacher. In addition, the schools represented in the Forums sample were more likely to be public, larger, and more urban than the average school (NCES, 1995, 1996).

Research Design

The Mathematics Learning Forums (Forums), provided the opportunity for an in-depth, contextualized understanding of the experiences of 35 teachers involved in three 8-week on-line courses. The research design relied on a combination of data-gathering tools including questionnaires (n=31), exit interviews (n=30), and content analysis of all public on-line exchanges (n=393). (For a more detailed discussion of the methodology see McMahon, 1996).

Questionnaires

Questionnaires were used to gather data in three areas:

1. Demographic and professional background: Size of school, type of community, age, level of education, years teaching, and current roles (i.e. teacher, staff developer, graduate student). In addition participants were asked to rate 10 factors that may have motivated them to enroll.
2. Technology availability and expertise: home or school on-line access, prior experience with computers and on-line activities, and skill level with on-line applications.

3. Professional interactions: local collegial environment, the respondent's professional development activities, and predispositions related to professional development and communication.

Six variables framed the professional interaction items: (1) teacher work group cooperation, (2) opportunities to exchange new ideas about instruction, (3) opportunities for reflection about practice, (4) capacity to give and receive feedback, (5) structures and norms that encourage a problem-solving approach to teaching, and (6) role of principal. These variables were selected based on the findings of previous research about dimensions of local collegial environment that correlate to teacher collegial interaction about instruction (Glidewell et al., 1983; McLaughlin, 1993; McLaughlin & Talbert, 1993; Smylie, 1989, 1992).

Questionnaire data were compared with each respondent's on-line participation patterns to identify factors that contributed to different degrees of participation. Statistical analyses used in this process included *t* tests, ANOVA, Pearson product-moment correlations, and Spearman rank correlations.

Interviews

Post-participation phone interviews gathered comparison data to determine how, if at all, the experience had affected participants' technical skills as well as their beliefs and attitudes about professional development. In addition, open-ended questions were asked to give participants an opportunity to share—in their own words—what they thought about the experience. The interviews were intended as a qualitative supplement and as a point of triangulation for findings from the questionnaire data and the observations of on-line activity. A number of questions were also designed to gather information about how network-based professional development complements, supplements, and influences existing professional communication.

In all, 30 participants took part in the interviews, including eight who posted one or fewer messages. Since these eight had little to no on-line exposure, they were asked a series of questions designed to better understand their reasons for not participating. Interviews lasted from between fifteen minutes (for those who had not participated on-line) to over an hour. With permission, the interviews were tape-recorded and then transcribed for analysis.

Transcripts of the interviews were imported into a qualitative analysis software package and indexed in the following ways. They were coded by participant, which allowed responses to be linked with participant's other data. Transcripts were also coded by interview question so that all responses to each question could easily be considered together. In addition, transcripts were read and coded for links to previously identified themes such as sense of on-line community and degree of reflection as well as emergent themes.

Content Analysis

For the content analyses, all 393 Forums messages were analyzed for patterns of: 1) Timing, frequency and volume of activity, 2) Types of messages participants posted (i.e. assignment related, logistical or technical concerns, general dialogue), and 3) Professional interaction and reflection.

Since much of the appeal of network-based professional development is based on its potential to increase professional interaction and facilitate reflection about practice, the third analysis focused primarily on looking for evidence of these two aspects of professional interaction. An initial synthesis of the messages provided a descriptive profile of the

overall on-line activity in the areas of interaction and reflection. From a combination of this analysis and information from the research literature, indicators of both interaction and reflection were identified and two scoring rubrics were generated. These scoring rubrics were used to determine interaction and reflection scores for each participant.

Summary of Findings

Question One: What was the nature of on-line activity?

The nature of the on-line participation was explored in three ways. First, it was examined for patterns of activity related to frequency, volume, and the timing of messages posted. Second, the content of messages exchanges was synthesized to provide a description of the general flow of on-line activity as well as a summary of the types of messages that were posted. The third analysis focused on evidence of interaction and reflection.

Delayed starts, protracted time between assignments, and unplanned breaks for school vacations combined to prolong each course well past the originally scheduled eight weeks. Overall activity was >40% less than anticipated in terms of course requirements. Fifteen percent of the participants who made it on-line posted as frequently as expected (at least twice a week), while over half of the participants (52%) posted less than one message a week. After the fourth week, participation began to decline and then, for many participants, stopped completely. In the end, five of the 31 teachers who logged on and posted at least one message completed the course.

The messages that were posted tended to be brief. Half of all messages posted were no more than 3.5 inches in length; one in ten messages measured an inch. The average message length for participants was positively related to the frequency with which they posted ($r=.65, p <.01$). When participants did post, they were most likely to post during the weekday evening hours (5pm - 11pm). In addition, weekday messages posted early in the morning, in the evening, or late at night tended to be longer than those posted during the daytime (8am - 4pm).

More than half of the on-line dialogue (59%) that occurred in each forum was assignment related, which included messages that responded to the facilitators' questions as well as messages that spoke to other participants' assignment postings. Activity that was not related to assignments can be categorized one of four ways: (1) logistical concerns, such as announcing vacations or checking on course packets that had not been received; (2) technical issues, for instance when the listserv was being reconfigured or a particular participant's computer hard drive crashed; (3) general sharing, which includes empathetic messages as well as asking for and giving advice on particular teaching resources such as materials, software, or games; and (4) dialogue about classroom activity and practice that was not directly related to an assignment and that went beyond sharing resources. Table 1 summarizes the activity in each of these categories.. The forum that had the least amount of overall activity had more than twice as many technical and logistical issue messages than the other two forums.

Table 1. Categories of messages participants' initiated on the Forums.

Type of posting	Forum P messages		Forum F messages		Forum A messages	
	n	%	n	%	n	%
Assignment-Related	37	55	67	69	78	78
Logistical Concerns	13	20	3	3	7	7
Technical Issues	7	10	2	2	6	6
General Sharing	10	15	18	19	8	8
General Dialogue	0	0	7	7	1	1
	67	100	97	100	100	100

A general reading of the on-line exchanges for evidence of interaction indicates that groups moved from congenial exchanges to dialogue about practice before activity declined. Only one participant did not interact with the group at all choosing to address his message only to the instructor. Many participants expressed an interest in becoming a "community of learners" and these words were replaced over time by actions that underscored this intent. Ninety-seven percent of the participants acknowledged each other's postings in subsequent messages. Sixty-two percent added new ideas to the discussion. Twenty-three percent of the participants posed questions to other participants and/or provided resource suggestions for others. Interaction began to wane as activity declined. As participants fell behind, they tended to address messages to the entire group but respond only to the assigned questions and not to each other's postings.

Evidence of reflection on practice varied across time and from participant to participant. Most participants (71%) expanded their responses to include not only descriptions of events, but also their own and students' reactions to the activities. These messages also provided more detail about how teachers approached activities and sometimes included student dialogue to illustrate a point. Twenty-nine percent of the participants posted at least one message that moved beyond a superficial discussion of techniques and began to address their underlying beliefs and motivations as well as implications related to teaching and learning. Many of the participants ($n=10$) reported in their interview (prompted by a question about what was valuable about the experience) that posting messages had caused them to reflect on their practice.

Question Two: What factors relate to participation?

Factors related to course design

Facilitative approaches and timing of workload were two components of course design that influenced participation. Effective facilitative strategies included: posting frequently, referring to participants by name, acknowledging participant contributions, synthesizing participants' postings, and asking probing questions. Facilitators were also more effective if they were well organized and technically proficient, the latter of which included an

understanding of the conversational as well as the technical conventions of computer-mediated communication.

The course workload, both on-line and off, proved problematic for 75% of the participants. Some teachers had trouble keeping up with the classroom activities they were expected to do with their students on which the on-line discussion was based. School calendars (especially from January to April, the months when these courses were run) are regularly punctuated with special events and field trips, reporting periods, vacations, and high-stakes testing—all of which detracted from the teacher's ability to focus attention and time on the course activities.

Other teachers had trouble keeping up with the on-line interactions. Perceptions of the on-line pacing and traffic varied considerably. Some participants were disappointed with the lack of on-line activity. For others, the amount of on-line activity—and the time and effort that accompanied the activity—was overwhelming. Most participants noted that composing messages took longer than expected and reading messages could also be time consuming or, in the words of one participant, “a chore.”

Demographic and professional background factors

Based primarily on a comparison of survey responses to content analysis findings, three main elements will now be considered: demographics; technical access and experience; and predisposition to professional communication and development. Data from interviews are used to triangulate and supplement this section.

Gender. Ninety percent of the Forums respondents were female. The skewed nature of the Forums sample reduces the power of gender-related findings. Nevertheless, there were statistically significant differences in the participation of males and females. Thirteen percent of participants who posted at least one message were male. Yet, males were responsible for only 2% of the 268 messages posted by participants. Females posted significantly more messages, posted a significantly greater mean amount of volume per message, and were more reflective and interactive in their postings than males (see Table 2).

Table 2. Descriptive statistics on number, volume, and quality of messages by gender

	Female Mean <i>n</i> = 27		Male Mean <i>n</i> = 4		<i>t</i> -tests		
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>df</i>	<i>p</i>
Number of messages	9.6	7.1	1.5	0.6	2.24	29	<.05
Volume of Messages	4.2	2.0	1.9	1.0	2.24	29	<.05
Quality of Reflection	2.1	0.8	0.8	0.5	3.3	29	<.01
Quality of Interaction	2.0	0.8	0.8	0.5	3.3	29	<.01

Age. Forums respondents ranged in age from 24 to 56, with a mean age of 36 and a median of 35. Younger participants were more likely to post more frequently and more

reflective and interactive messages than older participants; i.e., age was inversely related to the number of messages posted, $r = -.41$, $p < .05$, the level of reflection in messages posted, $r_s = -.30$, $p < .05$, and the level of interaction $r_s = -.40$, $p < .01$. Age was not, however, significantly related to each individual's mean volume of messages posted.

Professional background. Teaching experience for the Forums sample ranged from one to 27 years with almost three quarters (73%) having taught for no more than nine years. The primary position for 93% of the Forums respondents was classroom teacher, while staff developer described the other 7%. Positions were not always mutually exclusive, however, with several participants wearing more than one hat. Twenty-two percent of the group identified themselves as both teachers and staff developers, and 33% were currently involved in graduate studies.

During the interviews, at least a half dozen participants (from both public and private schools) commented that private school teachers had more disposable time than public school teachers. Perhaps that extra time made a difference, since those who taught at a private school posted more often ($M = 21.2$, $SD = 3.4$, $n = 3$) than those who taught at a public school ($M = 6.8$, $SD = 3.4$, $n = 27$), $t(2) = -3.6$, $p = .05$.

Motivation. Finding out what motivated participants to enroll in the Forums provided an understanding of what was appealing about this form of professional development. In addition, relationships between influential reasons for enrolling in the on-line Forums and participation were expected.

Forums respondents rated the extent to which each of ten factors influenced their decision to enroll in the Forums (see Table 3). Access to new ideas and materials and general professional growth received the highest ratings. On the other hand, peer recommendations, one's students always having trouble in this area of math, and gaining course credits for the salary scale seemed to have little impact on enrollment decisions. Indeed, less than one-quarter of the Forums respondents (23%) were taking the course for credit.

Table 3. Motivation for signing up for Forums in rank order by mean.

Factor	<i>M</i>	<i>SD</i>
Access to new ideas and materials	8.8	1.4
General professional growth	8.7	1.2
Interest in mathematical content	8.0	1.8
Opportunity to interact with other teachers	8.0	1.9
Opportunity to use/become familiar with technology	7.6	2.7
Reputation of Bank Street College	5.8	4.0
I was asked to participate by my school or district	4.8	4.0
My students always have trouble in this area of math	3.3	1.8
A colleague suggested I try it	3.1	3.8
Credit for the salary scale	1.2	3.0

Each factor ranked on a scale of 0 (no influence at all) to 10 (very strong influence). ($n = 30$)

There were a wide range of individual responses for several motives. For example, although nine respondents noted that being asked to participate by their school or district had no influence at all on their decision to enroll (0), seven noted that this same factor was

a very strong influence (10). Also, the reputation of Bank Street College was a very strong influence (10) for nine respondents but it exerted no influence at all (0) for seven.

Factors that drove Forums enrollment did not prove to be highly related to participation. However, the two factors that fell in the middle of the scale—being asked to participate by a school or district administrator and reputation of Bank Street College—were related.

Being asked to participate was inversely related to the number of messages a participant posted, $r = -.42$, $p < .02$, level of reflection, $r_s = -.36$, $p < .05$, and level of interaction, $r_s = -.48$, $p < .01$. One participant explained how this factor influenced her participation:

Because the district asked us to just try it. . . we had nothing to gain or lose from it. We did what we could. We tried it out, but my attitude was if I can't cut this, I can't cut this and it's not the end of the world. Where I think if I had paid for it, it would have been a different story. If I were taking for credit, I would have taken it. I tried to take it very seriously, but when things just got -- you know, between twenty-nine report cards and everything else, you were just like I can't get to that. If I was taking it for credit, I would have stayed up until three o'clock in the morning and done it.

In some districts, participants needed to show evidence of log-in time to district administrators. The need to provide evidence of participation prompted at least one participant to log on to read, but he reported that he felt he did not have enough time to compose and post many messages.

Motivation to take the course because of Bank Street College's reputation was positively related to the level of reflection, $r_s = .38$, $p < .05$, and interaction, $r_s = .36$, $p < .05$, of participants' postings. More than half a dozen of the participants were part of the Bank Street Mathematics Leadership program and had prior course work that may have honed such skills.

Technology Access and Experience

The following section explores how access to computers influenced on-line participation. Then, it examines the relationship between experience with technology and on-line activity.

Home Versus School Access

Participants with home access posted significantly more messages than those who had access only at school. Moreover, their interactive and reflective scores were significantly higher (see Table 4). In addition to influencing activity, evidence from the interviews indicated that ease of access to technology also reduced levels of frustration and influenced participants' perception of the pacing and workload of the course. This point will be discussed in more detail below.

Table 4. Summary of *t*-tests showing effect of home access on participation.

	<i>t</i> -tests			School Access			Home Access		
	<i>t</i>	<i>df</i>	<i>p</i>	<i>M</i>	<i>SD</i>	<i>n</i>	<i>M</i>	<i>SD</i>	<i>n</i>
Number of messages	2.43	26	<.05	4.4	3.6	8	9.7	8.3	22
Mean length of messages	0.99	18	<i>ns</i>	2.7	1.5	8	3.4	2.2	22
Level of Interaction	3.85	15	<.01	1.1	0.6	8	2.2	0.7	18
Level of Reflection	2.63	8	<.03	1.3	1.0	8	2.3	0.6	18

Logging on from school could take place prior to or after the workday or during 40-minute prep periods. More immediate job responsibilities, such as grading papers and planning lessons, were mentioned as factors that competed for attention when one tried to post during prep periods. Posting at school was also a race against the clock. More than a half dozen messages ended abruptly with the notice that the bell had or was about to ring.

Another issue that teachers at school had to confront was whether the computer would be available since computer labs at schools were often used for classes. Teachers with school access were more likely to report that they felt rushed and overwhelmed because they had 40 minutes to log on, read everything, and respond. This timeframe made it difficult to keep up with the course requirements.

As noted earlier, those who accessed only from school posted less frequently and also had lower interactive and reflective scores. What participants reported in their interviews confirmed that this effect was directly related to the challenges of school access:

Sometimes questions were raised and I didn't respond to them, not because I didn't care about answering the person but because when I went to respond, the computers were being used or there were problems with technology. So it ended up that I responded all at once. And I didn't really care for that.

A handful of teachers found ways around the 40-minute madness. In their interviews, they described solutions. One participant printed out messages and read them during her commute to work. At least two participants composed their messages before they sat down at the networked school computer.

A finding that was somewhat surprising is that messages posted from home were not significantly longer than those posted from school. A closer look at the data provided a clue for why this may have occurred. Two participants who posted at school had mean message lengths that were considerable longer than their counterparts ($M=4.5$ and 5.1 compared to $M=2.0$). As it turned out, one of the two composed her responses on a home computer and then posted from school. The other had considerable technical ability as evidenced by high technical skill scores, past experience on-line, and her familiarity with numerous e-mail shortcuts. If the data from these two participants are excluded from the calculation, participants with home access did indeed post significantly longer messages ($M=3.4$, $SD=2.2$, $n=22$) than those with school access ($M=2.0$, $SD=.97$, $n=6$), $t(19)=-2.2$, $p<.05$.

A few participants who had home access appeared to be well aware of their advantage. As one participant said:

[T]here is no way I would have been able to do what I did if I would have had to stay in school to do it. I mean, I would have, but it probably would have been a completely different thing for me because it would have been like get it done or write it at home and type it in at school or something like that. Where I could sit at home with a can of soda and the TV on if I wanted and type things in.

However, home access was not always convenient. While participants at school competed with students for access, participants at home competed with family members. As one participant shared at the end of her note:

It's time to go. My husband needs to use the computer and I promised him he could have it 20 minutes ago!

Another teacher with home access never participated because—since her husband used it for business and her daughter used it for school work—the computer rarely was available for her use.

Accessing the Forums also became a timely and difficult process when participants encountered technical difficulties—and difficulties emerged at every turn. Initial messages were peppered with apologies for delays caused by network servers, network connections, and hardware and software glitches. Later, messages voiced frustration over perpetual busy signals from network providers.

Prior On-Line Experience. Sixty-four percent of the Forums sample reported having previously used on-line services of some kind. However, prior experience was not significantly related to any aspect of on-line participation. In addition, proficiency with typing, e-mail, and listservs, all of which can be thought of as gateway skills for on-line participation, were not significantly related to either the quality or quantity of on-line activity.

Even so, activity for all was delayed as new users wrestled with the learning curve that accompanied trying to get hooked up, became familiar with the e-mail system, and gained comfort with the conventions of on-line communication. While four participants never made it on-line, more than a half dozen teachers reported they were able to solve the problem of getting on-line. Often, this success was due to help from friends.

When reading the messages posted, a noticeable difference between experienced and inexperienced users was their facility with on-line conventions. Using subject headers, remembering to sign their names, and adding “emoticons” such as : -) to lighten their messages were some of the noticeable differences.

Professional interactions

The relationship between three professional interactions factors and on-line participation is discussed below. The three factors are: level of professional activity, local collegial environment, and predisposition toward professional development and communication.

Professional Activity. During the 1995-96 school year, more than three quarters of the Forums respondents participated in a workshop (93%), attended a conference (83%), or

participated in an extended workshop (77%). Seventy percent of the group observed innovative teaching techniques. In addition, more than half mentored another teacher (67%), demonstrated innovative techniques to others (63%), or led a workshop (53%). Eighty-three percent of the Forums sample had a masters' degree, and at least three of the respondents were working to complete their thesis during the spring 1996 semester.

These numbers indicate that participants were committed to their own professional development and that they had professional development opportunities in which to participate. Indeed, this sample may have had too many opportunities. When asked whether they needed more opportunities for professional development, at least one quarter of the participants stated emphatically that they were getting plenty:

Personally I don't [need more professional development] because I get a lot of them, but theoretically I agree with that. I don't know how to answer that. I'm in about 100 networks so no, I don't need anymore. If I had anymore I wouldn't be able to get my job done.

A correlation was found between a participant's professional activity and the level of interaction his or her messages conveyed, $r = 0.32$, $p < 0.10$. Other than that, however, an active professional development schedule had no significant influence on the number, individual mean volume, or level of reflection of messages that participants posted.

Local Collegial Environment. Another component that was viewed as potentially related to on-line participation was a participant's local collegial environment. Respondents were asked the frequency with which they had engaged in a number of school-based activities over the past year. These activities had been found in previous studies to correlate with local collegiality. Respondents then reported the desired frequency for each activity. The difference between actual and desired frequency was calculated.

Thirteen percent of the respondents reported that local interactions happened exactly as frequently as they desired. For 83% there was a discrepancy between actual and desired. Of those, three-quarters desired only more frequent interactions, in particular opportunities to observe another teacher's practice and plan together. Desire for more frequent interactions was positively related to posting frequency, $r = 0.36$, $p < .05$.

Predisposition to Professional Development and Communication. Respondents were asked to rank a series of items that dealt with school social context and teacher collegial relationships. Their responses indicated that the Forums participants largely came from supportive local communities and that they were positively predisposed toward sharing with colleagues.

Before enrolling in the Forums, participants strongly agreed that peer discussions about improving math teaching are valuable. The group was slightly less likely to agree that they needed more opportunities for professional development, to share ideas and strategies with other teachers, or to reflect on their own teaching. Indeed, as discussed earlier, several respondents noted that they already had more opportunities for professional development, sharing, and reflection than their schedule could accommodate. None of these items was significantly related to any aspect of on-line participation.

Forums respondents equated little to no status differences to requests for advice among local colleagues. Participants were very likely to share a good lesson idea with school colleagues, and only slightly less likely to ask for help on a lesson that had not worked very well. They also tended to report being satisfied with the quality of discussions about math teaching they had with school colleagues. Being likely to share a

good lesson idea with school colleagues was inversely related to the mean length of messages posted, $r = -.54$, $p < .01$, as was being likely to ask for help, $r = -.37$, $p < .05$. In other words, the more likely a participant was to share with local colleagues, the less likely they were to post longer messages.

In similar fashion, satisfaction with the quality of local discussions about math teaching was inversely related to the number of messages posted, $r = -.37$, $p < .05$. In addition, while the group as a whole indicated very little sense of professional isolation, those who indicated a greater sense of isolation had higher interaction ratings, $r_s = 0.38$, $p < .03$.

The principal's role in school also made a difference to on-line activity. The more strongly a participant agreed that his or her principal had little idea of what happened in the classroom, the more likely they were to post a greater number of messages, $r = .53$, $p < .01$, to post longer messages, $r = .48$, $p < .01$, and to have a higher interactive score $r_s = .43$, $p < .02$. On the other hand, those who worked in schools where the principal actively encouraged professional development were more likely to post shorter messages, $r = -.35$, $p < .10$, and were less likely to have a high reflective score $r_s = -.34$, $p < .05$. Along the same lines, those who worked in schools where the principal participated in staff professional development posted less frequently, $r = -.55$, $p < .01$, posted shorter messages $r = -.49$, $p < .01$, and had a lower level of interaction in the messages they posted, $r_s = -.43$, $p < .02$. Overall, the more satisfied participants were with local collegiality, the less likely they were to participate in the on-line Forum. Apparently, their need for professional interaction was fulfilled at their schools.

Questions Three: How does NBPD supplement and influence existing professional interactions and growth?

Even with the challenges and the lower than expected level of participation mentioned earlier, teachers were likely to report that they would participate in another on-line course and, more specifically, they would participate in another Mathematics Learning Forum. Many teachers reported being more comfortable and confident with on-line technology after participating in the Forums. In addition, by the end of the Forums experience, the mean proficiency ratings of all technical skills had increased. However, only the increases in e-mail and listserv proficiency achieved statistical significance (see Table 4).

Table 4. Forums pre and post technical proficiency.

Activity	t-tests			Pre Mean (n=30)	Post Mean (n=22)
	t	df	p		
Typing	-0.76	47	ns	7.4	8.0
E-mail	-2.35	49	<.05	5.4	7.3
Listserv	-2.40	49	<.05	2.7	4.9
Internet	-1.19	48	ns	3.6	4.7

Activities rated on a 0 (no proficiency) to 10 (very proficient) scale.

For the majority of participants, the appeal of participating in the Forums was the opportunity to talk with other teachers. These interactions provided different ideas, extended current networks, and helped teachers become more aware of their own practice. A few participants found that working together on the Forums with a local colleague extended benefits of the experience. Others took the opposite stance, noting that not having a local colleague on-line allowed them the freedom to talk about issues and insights without having to worry about school politics.

Participating in this experience helped teachers develop skills and confidence as instructional leaders as well as classroom practitioners. For some teachers, their leadership growth was directly linked to on-line interactions. For many of the others, their new leadership role occurred locally. Participants shared materials and ideas from the experience with local colleagues. In addition, their participation in this new form of professional development was a point of curiosity about which others sought information.

The Forums experience had no influence on participants' beliefs and attitudes about professional communication. Indeed, for most participants, the on-line experience may have served to reinforce existing predispositions about professional communication. While the survey responses strongly indicated that dialogue among teachers was desired by all those involved, evidence suggests that many of the participants were defining that dialogue within traditional professional norms, for example, participants were likely to suggest that sharing about practice should be brief, on point, and not too liberally sprinkled with self-congratulatory remarks.

In spite of their own personal ambivalence with the experience, participants felt that network-based professional development had strong potential. This perception was based on two beliefs; first, that teachers need opportunities to talk with other teachers and second, that computer-mediated communication will be an important skill in our students' future.

Conclusions

Network-based professional development is far from reaching its potential. Many of the problems that remain are related to technical issues. The process of getting people connected to a course's on-line environment remains complicated for users who are not connected to any network at all. In addition, technical difficulties do not disappear once participants make the initial connection. Problems with hardware and software are likely to continue throughout the experience. How to use the technology is still far from obvious for many teachers since they have little to no prior experience with e-mail. And, knowing how to log on does not ensure that access to the network will be available. Those who access on-line courses from school may have difficulty finding a time when both they and a networked computer are available. Those who access from home may compete for access with family members as well as the thousands of other network users who dial into commercial carriers at the same time.

Additional problems emerge in at least three other areas. First, finding facilitators who have both technical and content expertise is difficult, and training does not ensure full understanding of the subtleties of effective on-line communication. Second, conducting course-related classroom activities with one's students is problematic for teachers who are in school systems (or who are at times in the year) that allow little flexibility for changing the established curriculum sequence. Third, participants' perceptions of on-line activity varies considerably depending on ease of access and technical proficiency. This variation makes it difficult to establish a pace for on-line activity that will be comfortable for all participants involved.

Nevertheless, network-based professional development does seem to hold genuine appeal that resonates with users, just as it does with researchers and designers. Most Forums participants agreed that they would enroll in another on-line course. Even those participants who would not participate again believed that network-based professional development is a beneficial option for other teachers. Teachers were pleased that the experience had made them more comfortable and confident with on-line technology. Their network-related skills also improved as a result of participating.

Much of the appeal of network-based professional development, for both users and researchers, is based on its potential to enhance teachers' options for professional development by: (1) supporting group discussions, (2) accommodating teachers' busy schedules, (3) integrating professional development with classroom practice, (4) supporting ongoing reflective dialogue, (5) reducing isolation, and (6) doing all of this while increasing teachers' familiarity with new technologies. Each of these six areas is discussed below, first in relation to its potential and then in relation to how each played out in the on-line experience examined in this study.

Supporting Group Discussions

An important aspect of developing as a teacher is engaging in professional dialogue about improving practice. Under the right circumstances, classroom practice is not only more likely to improve through such interactions, but those involved are less likely to experience frustration and burnout. The process of contributing to the discussion by formulating arguments or recognizing connections in the conversation provides cognitive and emotional elements that are important to the learning process. In addition, the availability of numerous points of view may serve to broaden one's perspective.

Computer-mediated communication technically has the ability to enable individuals to engage in such group interactions. All members of the listserv or conferencing system are automatically updated on any new postings, have access to the same previously sent messages, and have the ability to contribute to the conversation. The technological attributes of computer-mediated communication provide the potential for the right circumstances to be created for valuable group interactions.

Nevertheless, the right circumstances for group interactions did not completely materialize in these Forums. The foundation of communality had a shaky beginning as local technical difficulties delayed the start of almost half the participants until the third week. In addition, technical difficulties with the listservs raised suspicions from the beginning of the course that all messages were not being received by all members of the group. As some members began to post less frequently, momentum of the group dwindled, an effect predicted by the research literature (Riel & Levin, 1990). The unpredictable responses of one of the facilitators also may have contributed to the decline in activity on that Forum, a hypothesis that is supported by research that delayed responses can increase participant anxiety and discourage future postings (Chung, 1991; Feenberg, 1987).

Many of the participants engaged in congenial exchanges by addressing their messages to the group and sharing personal information. However, many noted that the experience was impersonal. In addition, while some in-depth dialogue took place and the facilitators challenged participants' ideas, group debates of any length occurred fewer than a half dozen times. Still, one-third of the group reported that the on-line interactions had made them more reflective about their own practice.

Exploring the extent to which the Forums provided multiple perspectives raises some interesting areas for further exploration. For the majority of the teachers, the appeal of participating in the Forums was the opportunity to talk with other teachers. In articulating this, many participants used the term "multiple perspectives" to describe what they meant. However, what many meant by this was the opportunity to gather a variety of tips and strategies. Few expressed a desire for the kind of challenging debates to which the research refers when emphasizing the power of multiple perspectives. In other words, the use of the term "multiple perspectives" to refer to the cognitive dissonance and learning that occurs when someone challenges another's idea was not what most teachers seemed to desire.

In addition, participants noted in their interviews that they desired perspectives originating from a greater geographical mix of teachers. An increased degree of interest was generated the further away another participant was located. While geographic diversity may contribute to the lure of the experience, this study was unable to address the linkage between geographic diversity and the diversity of perspectives offered. The extent to which network-based professional development experiences are enhanced by having participants from a greater variety of geographical locations presents an interesting question for further study.

Accommodating Teachers' Busy Schedules

On-line environments can be accessed anytime and anywhere with a microcomputer, communications software, and a modem. Therefore, they are appealing to teachers who tend to have busy routines that do not readily allow for regular group meeting times. In theory, participation occurs at a time that is convenient and at a pace that is comfortable for each individual. In practice, however, neither of these proved to be the case. Two factors detracted from the potential of convenience: lack of easy access and the inability to eliminate distractions. Differences in access also influenced participants' perceptions of pace.

For close to three-quarters of the participants, home access provided increased flexibility in terms of when they could participate in the Forums. However, home access hurdles did exist in the form of busy signals from network providers and in the form of family members who were competing for the same computer. Those who only had school access were more severely constrained. These teachers could log on Monday through Friday prior to or after school as well as during their 40-minute prep periods (except when someone else already was using the school's networked computer). Constraints to access, at home and particularly at school, served to decrease participation while increasing frustration.

The difference between home and school was more than convenience of access. Home and school also differed in terms of the level of distractions encountered. Interview data suggest that home access provided participants with more privacy and a more comfortable setting. This, in turn, made it easier for teachers to concentrate on the process of reading and composing messages, which made participation easier and more enjoyable.

In general, home access provided a more relaxed and generally uninterrupted environment. With no impending bell, teachers could take the time to switch gears from focusing on the tasks immediately at hand to focusing on the course dialogue. The most popular hours to post—5:00 in the afternoon and 10:00 at night—indicate that given the option, teachers will choose times when the distractions and interruptions of the day are likely to be minimized.

Those who posted at school had to choose between going to the computer lab, getting other work-related responsibilities under control, or just catching one's breath during the working day. In addition, school access meant public settings such as labs and libraries where teachers had little privacy. Here, they had to overcome the immediate distractions that likely arose—the noise of children at surrounding computers, the curiosity of colleagues, and any self-consciousness they may have felt in trying to compose with so many others around. Any reflective experience sandwiched into the middle of a hectic workday and curtailed by impending bells is bound to be a challenge.

The location of participants' access to the Forums greatly influenced their perception of the pace of on-line activity. The assumption that on-line communication can provide a comfortable pace of interaction is based on research that took place in white collar and higher education settings. In these environments, users often can access the network from their immediate workspace and typically use e-mail at least once, if not several times, a day. Thus, norms and expectations of comfortable pace in these environments may be different than those of users in different settings and circumstances, such as K-12 school settings. The Forums course designers took this difference into consideration and established an expectation that participants log on twice a week, a potentially comfortable pace for users who do not have desktop access. While two postings per participants does not sound like a lot of activity, it would have generated 18 participant messages per week in one forum, 24 in a second, and 20 in the third (not counting the facilitator's activity). The greatest number of participant messages posted to a Forum in one week was 16. Indeed, the overall amount of activity on the Forums was half of what had been expected and tended to be brief. Still, many participants reported feeling so overwhelmed with trying to keep up with the traffic that they stopped participating. On the other hand, several participants noted that they were disappointed with the lack of on-line activity.

The issues of pacing and critical mass are closely entwined and present a complex challenge. While critical mass is needed to hold a discussion, too many voices can make activity overwhelming. In the beginning, when few participants were on line, traffic was low. As the number of participants increased, the traffic increased. To those who were new to on-line communication or who had trouble accessing the messages, the number of messages quickly became unmanageable and many stopped participating. When they dropped out, the number of messages also dropped. Ironically, the only participants who remained were those who could have managed—and who desired—a greater number of interactions. In turn, these participants then got frustrated with the lack of on-line activity.

There is no clear indication of the ideal size of group involved in network-based professional development. Further study is needed to better understand the issue this dilemma presents.

Integrating Professional Development with Classroom Practice

New visions of professional development emphasize that if change is going to occur, discussion must occur in conjunction with implementation. Too often, structured professional development experiences occur in isolation from classroom practice. Teachers are often introduced to an idea at a workshop and then sent back to the classroom to implement it with little or no follow up. Network-based professional development seems well suited to support ongoing dialogue connected to classroom activity. It has the potential to enable teachers to try new practices in their classrooms while participating in an ongoing dialogue about those changes.

In theory, the activity-based discussions were one of the most powerful aspects of the course design. In practice, they also turned out to be one of the most stressful. In two

of the three Forums, the activities required were related to specific content topics. Teachers knew in advance that they would be focusing on fractions or probability and would be required to do activities with their classes that addressed these concepts. Those who had control over their curriculum could align the teaching of that concept with timing of the course activity. However, the delayed start of the course moved the activities back by several weeks, throwing off the schedule of those few who could plan.

Most teachers, however, did not have the flexibility to change the scope and sequence of their curriculum. This meant that in order to do the activities when assigned, some participants had to re-teach a concept while others had to jump ahead of schedule. In addition, as the annual ritual of high-stakes testing approached, teachers felt increasing pressure to expose their students to the types of concepts that might appear on the exam. This pressure to cover the curriculum competed with, and usually won out over, the pressure of completing the activity for the course. Not being able to keep up with off-line assignments influenced on-line participation as well since discussion was based on the activities.

Ironically, this aspect of the course design severely constrains the potential of the technology to overcome issues of time. If one of the major advantages of using on-line communication is the temporal flexibility it offers, then requiring participants to teach a specific lesson during a certain week is contradictory. Still, research indicates that successful on-line communities require a clear and common focus for successful dialogue (Riel & Levin, 1990), and teaching a predesigned standards-based lesson and then discussing it with peers who have taught the same lesson can serve as a clear and common focus. The desire for flexibility and focus needs to be balanced. The teachers who were in the Forum that was related to process (assessment) instead of content (fractions and probability) were better able to carry out the required activities. While still reporting that they felt overwhelmed by the amount of work required, the participants in the Assessment Forum could implement the activity assigned regardless of what content they had to address in a given week. Further exploration and experimentation are required in order to identify the course content areas, assignments, and time allocations for assignments most appropriate to both course purpose and medium.

Supporting Ongoing Reflective Dialogue

In order to improve their practice, teachers must have opportunities to reflect on practices that work and do not work, as well as opportunities to intellectually wrestle with new ideas of practice. Since on-line communication takes place via the written word, it has the potential to be highly conducive to reflection. The process of writing has cognitive benefits because it forces the writer to select words that accurately express thoughts (Vygotsky, 1962). To clarify writing, the individuals must clarify thinking. In addition, participants in online courses report increased attention to the content of written messages over those that are verbally presented (Harasim, 1986, 1990; Hiltz, 1986; Riel, 1990).

Using the reflection scoring rubric provides some basis for determining the level of reflection that was reached. Twenty-nine percent of the participants posted at least one message that was highly reflective. Thirty-three percent of the participants noted in their interviews that the Forums experience had made them reflect more on their practice, and half of these specifically mentioned the act of writing as a contributing factor. These figures may seem low if one considers that the Forums were one-credit graduate-level courses. On the other hand, the figures seem higher if one considers that 33% of the participants posted three or fewer messages, often only at the beginning of the course before content was being discussed. By their own admission, just having to slow down

and write about what they had done made teachers think about their practice. The act of sharing what was going on in their classroom practice was inherently reflective.

Participants noted, however, that making oneself understood clearly in writing was time consuming and they did not always have the time they desired to respond as thoughtfully and thoroughly as they would have liked. In addition, e-mail is a medium that encourages brevity. Because of limited on-screen text visibility, longer messages are physically more laborious to read than shorter messages, making them more difficult to comprehend and respond to. To counter this, users are encouraged to limit the number of points covered in each message; that is, to post a series of shorter notes instead of one longer message. However, a series of brief messages has the potential to lead to disjointed discussions because each message emphasizes an individual concept rather than relationships and connections between ideas.

Listservs are especially susceptible to the problem of disjointed discussions since messages are arranged in chronological order rather than by subject. Conferencing software may help to alleviate some of the organizational difficulties but are likely to pose challenges of their own; e.g., inconsistent participation due to users forgetting to access the separate on-line environment.

Still, interface aspects of computer mediated communication (CMC) and the communication norms that develop will dictate how on-line communication is used. More needs to be understood about how CMC can be used to support users expressing themselves, responding to others' points, and carrying on a discussion that becomes deeper than a series of "post-it note" exchanges. Research in this area will need to merge exploration of interface design, course design, and user norms.

Reducing Isolation

Teaching is often portrayed in research as a physically and mentally isolating profession. Professional isolation has been found to lead to personal frustration and alienation as well as diminished ability to critically reflect and improve one's own practice due to lack of comparison. Computer-mediated communication can support interactions between participants who are isolated. This has the potential to make it an especially appealing form of communication for teachers.

However, Forums participants did not fit the traditional profile of the isolated teacher. Instead, they tended to work in supportive local communities and to be extensively involved in programs that enabled them to interact with other teachers regularly. The teachers involved reported a low sense of professional isolation prior to taking the course, and many explained that their communication needs were sufficiently met through dialogue with local colleagues. The more satisfied participants were with local collegiality, the less likely they were to participate in on-line activity, which suggests that those participants who were less satisfied were likely to participate more. Many teachers in their interviews did suggest that this experience would be better suited for other teachers who felt more isolated.

Increasing Familiarity with New Technologies

A potential benefit of using new technologies to support professional development is that teachers will become better acquainted with the technology so that they can use it more effectively with their students. Several participants noted that becoming more familiar with on-line communication in order to use it with their students was the reason that they had enrolled in the course.

Participation in the Forums did indeed increase participants' familiarity with the technology as well as their skills, comfort, and confidence. While this increased familiarity will benefit the students of these teachers, it will also benefit future network-based professional development efforts. The start-up curve for these teachers will not be so steep the next time they enroll in an on-line course. In addition, increased facility makes a difference in the length of time teachers need to compose and read messages.

Summary

Lack of easy access to a computer and the network, lack of familiarity with communications applications, and frequency of technical glitches were three factors related to technology that cut into the Forums' potential success. These three issues served to impair group discussions as well as hinder the potential of flexible time and comfortable pace. Teachers' inability to veer far from the established curriculum during the course made integrating practice activities and on-line discussion challenging. In the face of these factors, the Forums' experience still managed to support reflective dialogue and increase teachers' familiarity with on-line communication.

Practical Suggestions

The following are a number of practical suggestions that emerged from the research.

Level of Commitment

Prior to teachers' enrollment in network-based professional development, the level of commitment needed to participate should be accurately communicated. This is particularly true for participants with little on-line experience. The time and effort that participants invested was dependent on three things: ease of access, prior experience on-line, and how much on-line activity was generated from other members of their Forum. These factors are not necessarily overwhelming barriers, but they must be clearly presented as a trade-off to teachers considering enrolling in a course. Teachers who are persuaded to enroll because they think on-line professional development will be more time efficient than a face-to-face course are likely to resent the amount of time the on-line course does take. As one participant pointed out, "Somehow people have to realize that this in a sense takes the place of driving to a location, sitting through class and driving back."

Furthermore, if network-based professional development is to become a viable option as a district initiative (rather than as solely an individual initiative), then district administrators must make a commitment to providing teachers time to read and respond to on-line communication. In addition, administrators must address the issue of access either by creating quiet, private on-line access options in the school setting or by helping teachers acquire home computers. An increasing number of districts are assisting teachers by loaning computers for use at home or setting up no-interest loans for teachers to buy their own computers.

Response Expectations

Perceptions of pacing will vary in relation to the ease with which individuals are able to access a computer. While many designers have desktop access, many teachers will be log on from a school computer lab. These two situations create vastly different perceptions of amount of activity and of reasonable time between responses. Lowering posting expectations and increasing response time may help to alleviate some of the pressure for teachers. Clearly communicating response expectations may counter the adverse effect on momentum this slowing of pace is likely to have.

School Calendar

Expectations for teachers trying out course-related activities with their students must be carefully considered within an understanding of the pressures imposed by curriculum and high-stakes testing. Given the lack of consistent scope and sequence across school districts, it is impossible to select one time of year when a group of teachers will all be teaching the same topic. The time of year when teachers seemed most able to try new activities with their students was late fall. This suggests that scheduling on-line courses for this time of year would be advantageous.

Facilitators

Facilitators influence participants' activity through their own on-line behaviors and need to be well acquainted with the technical and conversational conventions of on-line communication. There was a tendency for facilitators to gear the course toward those who were not participating—slowing the pacing, postponing assignments, and posting pleas for on-line participation. Attention may be better focused on those participants who are posting than on those who are not. Private e-mail and contact via the phone could prove to be more effective at finding out why participants are not on-line and encouraging them to post again. In addition, with this approach those who are on-line will not have to read the gentle reprimands and pleas for participation.

Technical Assistance for Inexperienced Users

Facilitators are only one part of the support system that needs to be available to participants. The assumption that all participants will be ready to log on from the very first day of class can not be made at this point in time. Pre-course sessions designed to orient new users to technical access and conventions of on-line communication as well as build technical proficiency might be a worthwhile addition to these courses.

Institutions, such as Bank Street College, who are designing and offering on-line courses also must decide how much technical assistance will be available during the course and how that technical assistance will be provided. The easiest and least expensive way to communicate with participants is e-mail. However, on-line communication poses a paradox if relied on as the only medium of interaction since those who can not access the network are unable to see the messages asking if they need help. While it may not be feasible to provide extensive technical assistance to all participants, taking the time to contact participants by letter or phone is a minor investment that is likely to deliver major dividends in terms of participant goodwill.

Until technology access is more consistent and use more widespread, institutions that are implementing on-line courses have two main choices. First, they can place the responsibility for gaining access primarily on the individual enrolling in the course. This decision greatly reduces the institution's responsibilities and expenses. Given this choice, institutions would be wise to target teachers who are already proficient on-line users. Second, institutions can assume a greater responsibility for providing technical support to those who have enrolled. This approach is based on the perspective that current on-line initiatives are an investment that will help generate a broader base of clients for future courses. Here, a "high-touch" approach can be used to compensate for the impersonal and often confusing nature of the technology. Institutions taking this approach will need to invest time as well as funds developing a strong technical support system until access, use, and local support systems are more reliable. The advantage to institutions that take this approach is that their courses will appeal to a broader population of teachers now. In

addition, positive experiences and word-of-mouth endorsements will help increase repeat and new enrollment.

Considering Costs

Network-based professional development is touted as more cost effective than face-to-face meetings. However, on-line professional development is not free of costs. The experience of a teacher whose school ran out of on-line time is a reminder that there are expenses involved that must be taken into account. In addition, costs associated with this type of professional development extend beyond paying for on-line time. Research shows that if a district is truly committed to having its teachers be successful with technology, it must be willing to invest in computer equipment, connectivity, technical support, and training to provide teachers the support they need to be successful (Hawkins, 1991; McMahon & Knuth, 1995). Dollars saved by the district in these areas will cost teachers in terms of energy and time as they try to work through the maze of linking on to the network.

Furthermore, districts and course designers will want to consider continuing to invest in initial face-to-face meetings prior to the on-line communication. The findings from this study reinforce the idea that CMC has weaknesses as a stand-alone medium. Indeed, any electronically mediated form of communication reduces interpersonal interaction. The challenge to districts, course designers, facilitators, and users is how to address this weakness. While face-to-face meetings are costly, they may well be a necessary initial investment for initiating cohesion and relationships between teachers that then can be maintained and built through electronic exchanges. In those courses where even an initial face-to-face meeting is not feasible, the exchange of photographs and limited use of audio conferences may help warm the impersonal nature of the medium.

Concluding Thoughts

In spite of their own personal ambivalence with the experience, participants felt that network-based professional development had strong potential. This perception was based on two beliefs; first, that teachers need opportunities to talk with other teachers and second, that since computer-mediated communication will be an important skill in students' future, teachers need to be prepared to help students learn to use it. Familiarity with new technologies helps teachers to develop informed strategies for integrating these tools into classroom activities. Still, one wonders how long this optimism can last—how many semi-successful experiences will teachers try before they conclude, as some participants already did, that on-line communication is not for them?

Currently, many of the challenges that threaten the potential of network-based professional development relate to technology. The findings associated with this study were clearly tempered by the immature stage of on-line use by teachers. The rapid growth of networking technology in the nation's public schools (Heaviside, Farris, Malitz, & Carpenter, 1996) suggests that this problem should decrease in the years to come as both access and teachers' proficiency improve.

But technological issues are not the only issues that need to be addressed. The tension between the need for teachers to talk with other teachers about practice and existing professional norms against doing just that in any depth did not magically disappear when teachers went on-line. Teachers require the same types of authentic, compelling purposes and environments as students. Exploration to determine which formats and approaches are most compelling to teachers must continue even as the technology is maturing.

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