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Transforming Professional Development: An Empirical Study to Determine the Key Aspects of Electronic Collaboration and Social Interaction in the Elementary Mathematics Teaching Community

Many recent journal articles, papers at scholarly conferences, books, monographs, and the popular media have made broad claims that online communities can support and enhance the growth of their members. However, our work suggests that most of the research that deals with the topic of online professional development is limited to statements of vision, opinion, curriculum integration ideas, and descriptions of putative benefits ascribed to the Web and other networks. It is difficult to find a research-based foundation, framework, or agenda for implementation. Studies of other technological innovations have shown that without explicit supports to and resources for considerable pre- and corequisite realignments to the values, belief systems, and behaviors that define a culture, the implementation of a technology will tend to be assimilative and substitutive. Although the technology underlying our online environment is of general applicability and is commonplace in some contexts, there is a lack of established literature describing the theoretical considerations and practical design constraints in an educational context. Nor are there descriptions of the necessary forms of supports and resources. Our proposed research is an attempt to develop theoretical background and to obtain data to inform the debate surrounding the complex issues of professional development and electronic learning communities.

Context

Teachers are being urged to pursue career-long professional development that moves beyond skills training and generic inservice models to a more flexible engagement with other experts in the field (Ontario College of Teachers, 1998). Research on teacher professional development (TPD) suggests that teachers need more opportunities (a) to access and discuss exemplary reform-based materials, (b) to co-construct and publish resources for new teaching practices,

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and (c) to collaborate on the creation of locally relevant solutions by participating in a professional community of practice (Lieberman & McLaughlin, 1995; Loucks-Horsley, Hewson, Love, & Stiles, 1998). Such opportunities, which require a commitment to sustained professional education, have become virtually nonexistent in Canada for a number of reasons including changes to funding structures, administrative reorganization, and large numbers of retirements. Our review of the recent literature suggests that the predominant forms of professional development (the *workshop* model and the *train-the-trainer* model) are not sustained, generative, or collaborative and do little to generate or sustain significant change to teacher practice and professional beliefs (Loucks-Horsley et al., 1998).

Teaching professionals must be able to form their own communities to change teaching practices and sustain school reform efforts (Lieberman, 1996). Learning increasingly takes place in a community (Pea & Gomez, 1992; Ruopp, Gal, Drayton, & Pfister, 1993), that is, individuals who share common interests and a particular form of discourse, together with the tools for building collaborative knowledge. Communications technology provides a promising means by which teachers can participate in such communities. However, research on initiatives aimed at supporting online multi-user environments has shown that such communities are difficult to create and sustain (Schlager, Fusco, & Shank, in press).

The purpose of our research is to develop a theoretical framework and to obtain empirical data to inform the debate surrounding the complex issues of TPD and electronic learning communities. We have drawn both on the existing research on TPD and on the particular needs of our community of teachers and learners. Our goal is to help the community to grow and flourish by embarking on an iterative design process that is sensitive to the changing needs of the community, but respects the constraints offered by research on TPD. TPD research suggests that the community must offer teachers convenient access to quality experiences and resources, and teachers must derive personal value, reward, and efficiencies from their participation in the community. We will draw on recent studies (Levin & Waugh, 1997; Schlager & Schank, 1997; Woodruff, Brett, & Macdonald, 1998) that show that there are three ways we might motivate participation: by offering access to exemplary, reform-oriented TPD content and expertise; opportunities and professional recognition for contributing to the community; and regularly occurring TPD-focused events.

Thus our research initiative into the area of computer-facilitated professional development fills an immediate need to establish the conceptual and technical cornerstones of an emerging field. It represents our attempt to make a significant contribution that may inform future policy and practice in designing and implementing telnet-based, multi-user virtual learning communities.

Community
Since November 1998 a community of 60 elementary teacher candidates who were enrolled in the Primary/Junior option in the BEd/DipEd program at Queen's University has been participating in an extended enrichment program called *The Joy of X*. The enrichment seminar comprised hands-on workshops where these teacher candidates were given opportunities to reconstruct their

personal knowledge of mathematics while experiencing the new vision of mathematics instruction that has emerged across North America (National Council of Teachers of Mathematics [NCTM], 1998). In each session these beginning professionals worked collaboratively, posing problems, formulating conjectures, and discussing the validity of various solutions while being guided and scaffolded by mathematics enthusiasts who framed appropriate contexts, facilitated discussion of the important emergent mathematical ideas, and steered them toward conceptual connections. The goal of the program was both to provide students with an opportunity to build a positive emotional relationship with mathematics and to help them to broaden their often limited perception of the discipline.

Now that they have graduated, they represent a geographically widespread community. Some will assume teaching positions in the United Kingdom, others in Mexico and Colombia, one in Arctic Quebec, and many throughout southern Ontario. Through *The Joy of X* sessions the teacher candidates have become a community. They have expressed their commitment to strengthen and forge ongoing bonds in this community electronically.

Purpose of the Study

Our study has grown from *The Joy of X* sessions. Other studies have documented the isolation new teachers feel (Lappan & Theule-Lubienski, 1994) and that "the hard work of moving preservice teachers to reconsider their beliefs and expectations about mathematics teaching and learning can be undone in a flash by 'a beginning job experience in a school whose culture promotes order in the classroom, teaching as telling and standardized test results as a measure of teacher success'" (Lappan & Theule-Lubienski, p. 257). In an attempt to reduce their feelings of isolation and sustain their practice, our pilot project is an attempt to learn how to develop a self-sustaining forum for collegiality given the knowledge that time and long-term support are critical aspects of change. We have taken major steps to ensure that the community already exists before the transition to cyberspace and that there is a sense of ownership among the members; for example, our community members have contributed not only to the design of the *Connect-ME* site but have also contributed to the content of curriculum resources.

Beginning in July, beginning teachers will have access to *Connect-ME*, an online community that will integrate a wide range of current Internet communication tools including e-mail, listservs, Web pages, and news groups. Through *Connect-ME* our geographically distributed teachers will have a place to meet and learn from one another and from experts in the field, including a number of educators involved in writing provincial curriculum and developing assessment. Participants will be able to access informational resources for joint review, share experiences with colleagues and mentors, or visit recommended Web pages via Internet links, including interactive video cases of teachers working to foster student learning through project-centered inquiry in the classroom.

Methods of Investigation

The research is (a) the identification of specific determinants in the successful use of computer technology as professional development and collaborative

learning tools, and (b) a description of the elements in the professional culture that simultaneously shape and are shaped by the technology. This is an empirical study that will use a qualitative methodology. The principal setting for the empirical study is the online environment itself, which has been seeded with 60 committed participants who will use the technology as a formal gathering place.

Data will be collected by tracking and analyzing the participants' online histories. In addition to documenting the number of log-ins, the context and content of the teachers' online histories will be analyzed (a) to determine the extent to which the use of this tool promotes mathematics education growth and inquiry; and (b) to articulate, if necessary, some possible interventions that would help to achieve this result.

The field notes will be summarized on a grid with categories for software interactions, exploratory behavior, pedagogical development, computer comfort and confidence, teacher-teacher interactions, teacher-expert interactions, student learning outcomes, and affective outcomes. The grid and coding system will be adapted and/or expanded as data are acquired in order to ensure that objective attention is given to as many aspects of the phenomenon as possible. These data will be supplemented by journals, responses to questionnaires, and participation in both informal and formal interviews. Focused interviews at the beginning and end of the school year will examine what the participants' professional development needs and preferences are (and whether they changed and were continuously met), what they needed to learn (and have gained knowledge about), and how the online community affected instructional practice and professional beliefs.

Preliminary Data
We have collected data from two sources. The first is from a questionnaire completed by the community of 60 teachers described above, aimed at determining the following: (a) their previous experiences and current comfort level with Internet use; (b) the types of resources that they had looked for and found on the Internet during their preservice mathematics education; (c) the type of support they foresaw needing during the first year of teaching; (d) their beliefs about the role of an online support network in their own professional development; and, (e) how they might participate in the creation and development of the online community. The second source is focused interviews that were conducted both with groups of 6-7 and with single participants. These allowed us to investigate more specific questions pertaining to the above issues.

The responses indicated that although all the teachers were regular e-mail users, their experience with the Internet varied greatly. There was an approximate 50-50 split between regular and irregular Internet users. Teachers had most often used the Internet to find activities and lesson plans and reported being disappointed in both the organization and quality of online materials. This phenomenon is continually reported in research (Lieberman & Mc-Laughlin, 1995). The teacher candidates ranked lesson plans and activities as their highest priority, followed closely by assessment resources, curriculum integration resources, and online help opportunities.

In order to address concerns about quality and applicability, each resource on *Connect-ME* will be annotated following the current practice at the most comprehensive and successful United States-based online community for math educators, the Math Forum at http://forum.swarthmore.edu/. In response to item (d) above, the teachers articulated the need for discussion with experts, as well as peers, in areas such as curriculum changes, integration of technology and curriculum, and special needs. Direct and immediate access to advice and assistance is ranked by teachers as the most helpful feature in becoming more effective (Merseth, 1992). We have thus decided to assign discussion leaders and moderators for each of these areas, drawing on the expertise of both teachers and academics in Ontario, all of whom are familiar to the teacher candidates. Finally, the teachers were most interested in sharing the lesson plans and activities that they themselves had created over the course of their preservice year. They also indicated a strong interest in participating in summer workshops to continue creating and exchanging ideas.

By July 2000 we will have completed the first major report of our study, the development of an electronic learning community aimed at sustaining the professional and epistemological growth of a group of individuals who came together through a mathematics enrichment seminar. Throughout the year we will post preliminary findings from the study on our *The Joy of X* website in *Connect-ME*. You are invited to visit us at http://hydra.educ.queensu.ca/CM/.

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