Distance-mediated mentoring : a telecommunication-supported model for novice rural mathematics and science teachers
by Jennifer Lyn Luebeck

A thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Education in Secondary Curriculum and Instruction
Montana State University

Abstract:
Rural educators face unique professional challenges and limitations. This study investigated the effectiveness of an innovative distance-mediated mentoring program for rural novice mathematics and science teachers. Four purposes were pursued: 1) characterize and document the nature and development of the mentor-novice relationship; 2) describe how discourse influenced the novice teachers perceptions about mathematics and science teaching; 3) determine whether telecommunication effectively supported a distance-mediated mentoring relationship for novice rural teachers; and 4) investigate program effects on novice teachers' attitudes, concerns, and professional growth.

A qualitative research design was implemented during academic years 1996-98. Primary data collection focused on nine rural novice teachers and their mentors and included three sets of interviews spanning three semesters, field observation of classrooms, schools, and communities, and analysis of electronic mail messages over a four-month period. Supporting data were collected during observation of workshops and training sessions, and through surveys administered to all program participants in early 1997 and 1998.

Categories of mentor-novice communication were identified: curriculum and content, validation of teaching practice, classroom and school issues, moral support, and social talk. Impact on mathematics and science teaching was accomplished by: sharing materials and activities; planning units and projects; locating resources; classroom and student concerns; long-range curriculum design; and improvement of teaching practices.

Professional growth (for both novices and mentors) occurred through individual contact with partners and interaction within the larger mentoring community in both face-to-face and on-line venues. Telecommunication was highly valued by successful users. Technical difficulty curtailed access for a significant number of teachers, but they maintained successful relationships via telephone, mail, and meetings.

Recommendations include: 1) consider subject and grade level, teaching responsibilities, and school size and setting when matching partners; 2) encourage early face-to-face encounters; 3) educate mentors to perceive novice needs and monitor intervention outcomes; 4) limit structured support to two years and/or implement ongoing evaluation based on systematically increasing expectations; 5) support a telecommunication component with early and repeated user training and remediation as well as provision of alternative modes; and 6) design specific, structured on-line conference folders and activities to motivate meaningful participation by novice and mentor teachers.

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APPROVAL

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This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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ABSTRACT

Rural educators face unique professional challenges and limitations. This study investigated the effectiveness of an innovative distance-mediated mentoring program for rural novice mathematics and science teachers. Four purposes were pursued: 1) characterize and document the nature and development of the mentor-novice relationship; 2) describe how discourse influenced the novice teachers' perceptions about mathematics and science teaching; 3) determine whether telecommunication effectively supported a distance-mediated mentoring relationship for novice rural teachers; and 4) investigate program effects on novice teachers' attitudes, concerns, and professional growth.

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Recommendations include: 1) consider subject and grade level, teaching responsibilities, and school size and setting when matching partners; 2) encourage early face-to-face encounters; 3) educate mentors to perceive novice needs and monitor intervention outcomes; 4) limit structured support to two years and/or implement ongoing evaluation based on systematically increasing expectations; 5) support a telecommunication component with early and repeated user training and remediation as well as provision of alternative modes; and 6) design specific, structured on-line conference folders and activities to motivate meaningful participation by novice and mentor teachers.

CHAPTER 1

INTRODUCTION AND LITERATURE REVIEW

Introduction

Rural educators face unique challenges and limitations in terms of time, resources, and professional growth. For several years, educational researchers have been investigating the needs of beginning rural teachers and factors which contribute to the professional isolation of teachers in rural settings (Carlsen & Monk, 1992; Davis, 1987; Lemke, 1994; Reed & Seyfarth, 1984; Veenman, 1984). In response to their findings, a variety of programs and experiments have been initiated in the past decade in an attempt to enhance the professional development of rural teachers. A substantial number of those programs have explored the use of mentoring partnerships (Hersh, Snyder & Stroot, 1993; Schatzman, 1995) and, more recently, the use of various telecommunication environments for professional exchange (Kellogg, 1996; Muscella & DiMauro, 1995; Rogan, 1997). The body of knowledge documenting the implementation and success of beginning teacher induction programs, mentoring relationships, and computer networks which affect rural teachers is growing steadily.

To attend to the special problems created by vast distances, isolated communities, and small school enrollments, telecommunication has been introduced as a way to connect beginning teachers with appropriate mentors who may be separated by hundreds of miles and several hours of travel. Such a *distance-mediated* mentoring program was initiated in Montana in Spring 1995 by the Systemic Teacher Excellence Preparation (STEP) Project, a National Science Foundation-funded Collaborative for Excellence in Teacher Preparation (CETP) which was designed to produce broad changes in the teaching of mathematics and science throughout Montana. The Early Career Support Program (or ECS Program) was one component of STEP's five-year commitment to nurture teachers through the years spanning the teacher training process as well as through the first years of career experience:

> The Early Career Support Component of STEP is perhaps the most exciting piece of the STEP [P]roject in that it allows teachers in the field who have a vast experiential base to directly impact the thinking and teaching of teachers early in their careers. Through the mentor/early career relationship people learn from each other as they quickly discover that each brings an exciting perspective to the partnership. (Graves, 1996, p. E-4)

Numerous benefits of mentoring such as provision of products and materials, improved self-perception, and enhanced professional growth have been documented through research and are described in the review of literature later in this chapter. Successful mentoring has been associated with contributing factors such as time to meet, proximity of classrooms, and similar assignments of grade level and content area (Wildman, Magliaro, R.

A. Niles, & J. A. Niles, 1992). The introduction of a distance-mediated mentoring model opens a new avenue of inquiry: Can the benefits of site-based mentoring be preserved or even enhanced in a setting where novice teachers and their mentors are separated by distance?

Trade-offs in quality and opportunity are inevitable in the shift from a site-based to a distance-mediated mentoring model. For example, distance-mediated mentoring affords rural teachers a greater opportunity to connect with experts in similar subject and grade level areas. An off-site mentor can discount school politics and add objective external perspective when reacting to a novice teacher's concerns. Networking experiments have shown that trust and warmth are not necessarily sacrificed in a distance-mediated setting, and the inclusion of a telecommunication component widens the window of opportunity for interaction. However, distance-mediated mentoring necessarily falls short in its ability to help novice teachers with school and classroom specifics, and may require adaptations to support elements of the teaching process that are easily dealt with through face-to-face contact and observation.

Research results indicate that "Mentoring in some cases has proven to be a less than ideal reform tactic, especially when programs have been implemented with too little conceptual understanding of mentoring, unrealistic expectations, and poorly thought out implementation strategies" (Wildman & Magliaro et al., 1992, p. 205). To defend against such possibilities,

the STEP Project's Early Career Support Program was crafted around a nationally-respected mentor training curriculum and was modestly implemented until its effectiveness and potential for growth were evident. This study sought to assess the effectiveness of distance-mediated mentoring against the standards set by previous research on site-based mentoring programs. As the study progressed, those standards were refined by identifying and incorporating the study participants' own perceptions of effective mentoring.

Purpose of the Study

The purpose of the study was to investigate the effectiveness of a distance-mediated mentoring program for rural mathematics and science teachers in Montana. Special attention was paid to the development and maintenance of the mentoring relationship and to the application and perceived value of the program's telecommunication component. To achieve these ends, data was collected, analyzed, and interpreted in order to:

1. Characterize and document the nature and development of the relationships established between mentors and beginning rural teachers in a distance-mediated mentoring program.
2. Describe how discourse between mentors and beginning rural teachers in a distance-mediated mentoring program influenced the beginning teachers' perceptions about mathematics and science teaching.

3. Determine whether telecommunication effectively supported a distance-mediated mentoring relationship for beginning rural teachers.
4. Investigate the overall effects of the distance-mediated mentoring relationship on beginning rural teachers' attitudes and concerns about teaching, as well as their professional growth and development.

Related Questions

The following questions were investigated in relation to the Montana STEP Project's Early Career Support Program as a prototype distance-mediated mentoring program:

1. What were the nature and frequency of the exchanges and discourse that were part of the mentoring relationship?
2. In what ways did the mentoring relationship change over the course of the academic year?
3. How did the mentors attempt to meet the needs and alleviate the concerns of the beginning teachers during the academic year?
4. In what ways did the mentors and beginning teachers exchange ideas and materials related to mathematics and science teaching?
5. How were shared ideas and materials related to mathematics and science teaching incorporated by the beginning teachers?
6. Did the mentor teachers follow up on science and mathematics teaching ideas and materials which they shared with beginning teachers?

7. How was telecommunication used to maintain and strengthen the mentoring relationship?
8. How often did the mentors and beginning teachers exchange electronic mail? Access bulletin boards? Obtain on-line materials?
9. What changes occurred in the attitudes of both beginning teachers and mentors toward telecommunication during the academic year?
10. Were the beginning teachers satisfied with telecommunication-based mentoring? (Did they feel "mentored"?)
11. What were the initial concerns of beginning teachers, and how did they change as the year progressed?
12. In what ways did the beginning teachers evidence professional growth attributable to mentoring during the academic year?

Significance of the Study

Beginning teachers without support may become disillusioned and overstressed; their reaction is often to retreat to the safer ground of authoritarian teaching methods and teacher-centered instruction (Odell, 1990, p. 15). When this happens, students are denied the experiences derived from reform mathematics and science instruction (e.g. cooperative group work, hands-on experiences, and learning through discovery). Such constrained teaching situations are only compounded by high teacher turnover. If new teachers arrive every few years in a small school, the students who pass

through their classes may never benefit from the creative additions to curriculum and varied teaching strategies that proliferate in direct proportion to a teacher's growing sense of familiarity and confidence in the classroom.

Odell offered three main goals of mentorship: to provide guidance "so as to promote the professional development of beginning teachers" (p. 16); to provide support and information "so as to reduce the concerns of beginning teachers" (p. 17); and "to increase, through mentoring, the retention of beginning teachers" (p. 17). She added that:

> It is not extreme to conclude that if the realities of beginning teaching are not dealt with constructively, and if beginning teachers are not appropriately supported and encouraged when they are most vulnerable, we risk having beginning teachers revert to less effective teaching methodologies. We also risk having promising new teachers leave the profession. (1990, p. 15)

The findings of this study add to the knowledge base regarding mentoring programs nationwide, particularly those for rural teachers. Through the use of telecommunication and distance-mediated mentoring, STEP's Early Career Support Program addressed each of the factors limiting rural professional development as defined by the Northwest Regional Educational Laboratory: geographic isolation, professional isolation, community attitude, time, fiscal resources, and irrelevant opportunities (Miller, 1991, pp. 5-6). If shown to be successful in enriching, motivating, and retaining rural mathematics and science teachers, the ECS Program can serve as a prototype for other programs that provide mentoring for new teachers in

school districts where resources (both human and financial) do not allow for an in-district mentoring program.

Review of Relevant Literature

The STEP Project's support program for beginning Montana mathematics and science teachers blended mentorship, telecommunication, and rural teaching issues in a unique and innovative combination. An extensive search of the literature unearthed virtually no research on programs that have addressed all of these areas simultaneously; however, numerous studies have been conducted in each of the areas individually and are summarized here.

Rural Isolation and Beginning Teacher Needs

Enochs (1988) characterized the rural community by its "relatively small size, remoteness from urban service centers, and a non-industrial economy" (p. 2). He qualified this definition by noting that due to consolidation a remote rural school may have a relatively large student population, and that schools with small enrollments may be located close to major cities. In a 1994 report on rural schools for the Department of Education, Stern adopted the U.S. Census Bureau definition of "rural" areas as places in open country outside urbanized areas, or in communities of less than 2,500 residents, or where population density is less than 1,000 residents per square mile. By that definition, all of Montana, save for a handful of

cities and their environs, can be classified as rural. And within Montana and states with similar population density, there exist regions where isolation is far more extreme than Stern's definition implies.

Teaching in a rural school can have many positive implications. After a review of literature, Lemke (1994) determined that most rural teachers are "home-grown," having been raised near where they later teach. She went on to list several benefits of rural teaching: small class sizes, more personal relationships with students, greater potential for individualized instruction, increased student and parent participation, and greater teacher impact on decision making. However, difficulties are also inherent to rural teaching, many of them arising from the concept of isolation.

Aspects of isolation in rural schools have been identified and categorized in a variety of ways. Davis (1987) collected information from over 600 teachers in rural regions of Ontario and Australia. He was able to identify three sub-categories of isolation: (a) social isolation, which implies separation from family and friends; (b) cultural isolation, or the absence of movies, plays, concerts, and sports events; and (c) professional isolation, which prevents teachers from sharing experiences and learning from each other (pp. 12-13). He also discovered that isolation is not necessarily a direct consequence of rurality; some teachers did not perceive themselves as isolated although they taught in rural areas.

Rural teachers, whether they feel isolated or not, can be overwhelmed by the needs and expectations of the community. In an interview study of 24 newly appointed rural teachers in Australia, Gibson (1994) discovered that 79% of them were concerned with problems arising from community situations. Gibson recommended further effort on the part of induction programs:

> Create within these teachers an awareness of community dynamics that influence the teaching-learning environment. . . . The expectations of stakeholder groups may be of great importance to the preparation of teachers unfamiliar with rural communities and the role of the teacher in those communities. (p. 74)

In 1991, the Northwest Regional Educational Laboratory conducted a survey of nearly 100 teachers, parents, and other education-connected individuals in an attempt to define professional isolation issues for small, rural schools. In his summary of the findings, Miller listed six factors limiting professional renewal for rural teachers:

1. Geographic Isolation: Thirty or more miles to another school, institution of higher education or other sites providing opportunities for professional renewal.
2. Professional Isolation: The lack of opportunity to share and interact with peers.
3. Community Attitude: Community attitudes and beliefs appear unfavorable toward professional development activities during school hours.
4. Time: Demands on time outweigh available time.
5. Fiscal Resources: Limited or non-existent financial resources for supporting professional growth opportunities.
6. Irrelevant Opportunities: Professional opportunities do not match the personal or instructional needs of rural educators. (1991, pp. 5-6)

Stone (1990) cited social, cultural, geographic, and professional isolation as the most common reasons that teachers leave rural positions. She also cited the demands of "rural reality" as defeating for teachers: examples include teaching multiple subjects in multi-grade classrooms, being expected to prescribe education programs for special needs students, and leading extracurricular activities.

The difficulties inherent in rural teaching are particularly acute for new teachers because they lack both experience and resources. Although findings regarding beginning teacher needs vary somewhat, areas of universal deficiency include classroom management and discipline, contact with others beyond the classroom, availability and adequacy of teaching materials, working with individual and exceptional students, and other issues related to motivation and self-improvement (Reed & Seyfarth, 1984; Veenman, 1984).

Science and Mathematics

Science and mathematics teachers face unique obstacles in providing instruction for rural students. In a comparative study of rural and nonrural science teachers in Texas, researchers analyzed a 100-item survey returned by 183 science teachers in 39 counties. Both the rural and nonrural groups listed similar areas of greatest need: "'identify free instructional materials,' 'motivate students to learn science,' 'use hands-on teaching methods,' 'learn about science career opportunities,' and 'use computers for science

instruction'" (Ogden, Horn, & Chao, 1994, p. 22). The rural teachers in the sample expressed a significantly higher need for more collegial interactions and ways to alleviate the burden of multiple class preparations.

Nationally, rural science teachers differ significantly from their more urban colleagues in terms of preparation. Carlson and Monk (1992) examined data produced by the Longitudinal Study of American Youth, which included 456 middle and secondary science teachers from 93 schools. Through t-tests and multivariate analysis they concluded that rural science teachers took fewer science and science methods courses and were more likely to have majored in education but less likely to have majored in a science field, conditions which indicate an increased need for mentoring support.

Sunal (1991) felt there was a lack of research examining how variables in rural science education affect student science achievement (p. 202). His own study involved 105 science teachers representing rural portions of an Appalachian state. His three-part data collection package included a survey about school and classroom conditions, a questionnaire investigating teachers' perceptions and evaluation of the science program in their schools, and interviews and site visits to a subgroup of participants. He found that:

> Teachers in small schools identified a need for inservice programs which would enable them to get together with other teachers both within the county system and regionally to share ideas. Other needs identified were free materials workshops and laboratory activity related workshops. Nearly one-third of teachers in small schools commented on a need to relieve the isolation they often felt since typically there were no other teachers in a particular specialization, such as chemistry, in their school. (1991, p. 206)

By quantifying his results, Sunal was able to correlate teacher and school variables with science achievement among rural school students as measured by the Comprehensive Test of Basic Skills (CTBS). At the ninth grade level, he found a significant positive relationship ($p < .05$) between CTBS scores and a group of school and classroom variables which included (a) availability of certified teachers with science majors and (b) opportunities for teachers to interact professionally with their peers.

Literature on the limited resources and program deficiencies faced by rural science teachers is more accessible than is data specifically referencing rural mathematics teaching. Mathematics teachers do have unique professional needs: they must be familiar with alternative methods of instruction and assessment; able to represent mathematical ideas using manipulatives and technology as well as paper and pencil; and able to create a variety of learning environments to suit the ages and abilities of their students. The National Council of Teachers of Mathematics recommended that "Teachers should be able to turn to colleagues for information concerning any aspect of mathematics education in order to expand their views of mathematics, their resources for teaching, and their repertoire of teaching and learning skills" (1991, p. 169). In a rural setting, such colleagues may be few and far between.

Teacher Induction and Mentoring Programs

Teacher induction is the term generally used to describe entry into the teaching field and the support that is planned for new teachers entering the profession (Veenman, 1984, p. 165). Zetler and Spuhler defined induction as a set of procedures "the collective intent of which is to facilitate the pace and quality of the new teacher's development into a competent practicing professional" (1997, p. 3). Teacher induction programs typically have included the provision of paperwork about regulations and procedures, early orientation visits, attendance at beginning teacher groups, special conferences and workshops, and partnership with experienced teachers (Veenman, 1984, p. 165).

Hersh et al. (1993) listed five goals that are often addressed by induction programs: (a) the improvement of teaching performance; (b) increased retention of promising beginning teachers during the induction years; (c) promoting the personal and professional well-being of beginning teachers by improving teachers' attitudes toward themselves and the profession; (d) satisfying mandated requirements related to induction and certification; and (e) the transmission of the culture of the system to beginning teachers (p. 3). Hersh gave special emphasis to mentoring, noting that "Those teachers who are involved in a mentoring program are more likely to stay" (p. 3). Zetler and Spuhler (1997) agreed that while mentoring is not the only form of

induction, their study found it to be the single best form of assistance a district can provide for its new teachers.

Mentoring plays a role in new teacher retention. Montana's Office of Public Instruction does not monitor retention rates or keep other statistics related to teacher turnover among new teachers in the state. However, at the national level, researchers estimate beginning teacher attrition at 30 percent within the first two years of teaching, and ranging from 40 to 50 percent within five years (Odell, 1990; Odell & Ferraro, 1992). Following a four-year retrospective study of teachers who received mentoring during their first year, Odell and Ferraro found that "only four percent of those teachers had left the profession each year" (p. 200). This rate paralleled the annual attrition rate of 4.1% for teachers at all experience levels nationwide, and implied a five-year attrition rate which was roughly half that for beginning teachers in general. "This suggests that mentoring may have reduced the high attrition rate typically found for beginning teachers to the lower attrition rate usually found for more experienced teachers" (Odell & Ferraro, p. 203).

Beginning teachers receive multiple benefits from experienced teachers' ability to interpret classroom situations and modify educational decisions. Experienced teachers, for instance, display decision-making skills that are lacking in novice teachers. In a comparative study, Westerman (1991) found that where expert teachers related new information to prior learning, assessed student understanding, and set the stage for new learning, "Novices

did little to relate present learning to past or future learning" (p. 297). She also found that novice teachers took curriculum guidelines much more literally than their expert counterparts, and demonstrated less flexibility in lessons: "The narrow focus of their planning, based almost solely on the curriculum objectives, seemed to limit what went on in the classroom" (p. 299).

In a study of 39 first-year teachers who graduated from three different teacher education programs at Harvard University, Merseth (1991) learned that "Although researchers know that first-year teachers have similar concerns, novices often do not know this. They frequently believe that they are the only ones with discipline or management questions or worries about student motivation" (p. 144). The existence of a mentor provides both an awareness of the bigger picture and an emotional outlet:

> The chance to interact with a colleague by asking questions, sharing materials, or planning collaboratively has other benefits of an emotional nature. The beginning teachers sense this support from the helping or nurturing attitudes of their colleagues and depend upon it to get them through those first, difficult, lonely months. (Wildman, Niles, Magliaro, McLaughlin, & Drill, 1987, p. 12)

Mentors receive reciprocal benefits from partnership with a beginning teacher. Hofmann & Feldlaufer found that adopting the mentoring role can improve teachers' perceptions of themselves as professionals and improve their own instructional skills (1992, p. 101). In their study of a Connecticut mentoring program, they determined that teacher professionalism was enhanced through collegial relationships, the support of new teachers, and

promoting and maintaining professional standards. Mentor teachers in the study cited professional growth opportunities as having a major impact on their self-perceptions and improvement of instruction (pp. 102-103). These responses are similar to those of Ohio mentor teachers studied by Hersh et al., who noted an increased sense of confidence and professionalism even as they helped beginning teachers improve their instructional and management techniques (1993, p. 11). Mentoring has been shown to influence professional growth in novice teachers; one purpose of this study was to determine whether distance-mediated mentoring can achieve the same goal.

The role of the mentor teacher is flexible and many-faceted. Mentors should encourage new teachers to reflect on their teaching; they should be able to share materials, serve as a sounding board, observe their colleagues in the classroom and provide feedback that will link theory to practice and encourage reflection. "They must help new teachers see the interdependence of good instruction and classroom management" (Shulman, 1989, p. 6). Wildman & Magliaro et al. (1992) analyzed the responses of 150 mentor teachers who were asked to describe their activities. They identified six categories of direct assistance: (a) encourage reflection; (b) direct and support novices' actions and plans; (c) provide direct assistance in developing a process, policy, or product; (d) provide a menu of information and products for the novice's possible use or modification; (e) provide products and ideas that enable the novice to solve a problem; and (f) encourage and support the

novice teacher (pp. 208-9). The mentor teachers also listed contextual factors which influenced the success of the mentoring relationship. The three factors they considered most critical were time to meet, proximity of classrooms, and similar assignments of grade level and content area (1992, p. 210). For a rural teacher, proximity may be impossible; it remains to find a way to match rural novices with mentors teaching similar grade levels and/or content areas, using a medium that is flexible in terms of time.

Telecommunication

In an isolated rural school, the nearest colleague with strengths in a beginning teacher's areas of concern regarding content area and grade level may be many miles away. Involving beginning rural teachers in a mentoring relationship with an experienced teacher in a similar setting is now feasible using telecommunication, even if the two teachers and their classrooms are separated by hundreds of miles.

As telecommunication networks offering electronic mail, bulletin boards, and real-time conferencing become ever more accessible, they increase the potential for effective interactions between teachers in various settings. Besides its ability to link sites that may be separated by hundreds of miles, computer conferencing offers other advantages. One of its greatest benefits is *asynchronous* communication, which gives teachers the freedom to interact at any time of day or night and the ability to save items for further consideration and elaboration at a later time (Clarken, 1993). Interviews

conducted in a study of thirty-nine beginning teachers revealed that the 24-hour availability of the computer was considered a benefit by the beginning teachers. "No matter when the beginner logged on to the system, there usually were messages from other participants. One participant noted, 'It's easier to schedule the computer, which is significant. I can do it at 3:00 a.m . . . . if I want'" (Merseth, 1991, p. 144). In another study, student teachers who used a communication network revealed that the most popular usage hours were from 8:00 p.m. to 12:00 midnight (Thompson & Hamilton, 1991, p. 6).

Clarken (1993) found that on-line conferencing also engendered a decreased emphasis on the social or political aspects of a discussion in favor of greater emphasis on what was being said. Because it released the conversants from social and political constraints, telecommunication provided a safe forum for the exchange of personal feelings and frustrations. From her study of beginning teachers, Merseth (1991) concluded that privacy and confidentiality were important factors in using a computer network. One of the respondents in her follow-up interviews wrote that "You could ask questions that you wouldn't ask at your school. It might be too inflammatory. What do you do if the department head's a jerk? You can't really ask that at school!" (1991, p. 145).

According to Murphy, Merseth, and Morey (1990), two specific features set electronic network support apart from more traditional forms of new teacher assistance: first, "all the participants give advice to each other" (p. 35),

promoting a professional development model that defines the help-giver as a collection of individuals rather than one person; and second, much of the advice comes from "colleagues of equal status, negating much of the expert-novice interaction" (p. 35). Although they recognized the importance of assisting new teachers with specific site-based needs, Murphy et al. found that a computer network, by its collective nature, can also address local concerns:

> This local detachment, combined with multiple perspectives of different individuals from diverse subject matter fields, generalizes the specific incident or situation to a higher level of abstraction. . . . [This] seems to foster the ability of novices to perceive more broadly and more generally, helping them gain perspectives on their own teaching and on the teaching of others. (p. 35)

Communication by computer network lends itself to thoughtful expression and thereby stimulates beginning teachers' reflection skills (Cadigan, 1993, p. 33). Concisely presenting a problem to other network participants requires making decisions about which aspects of the problem are most important. Teachers in Merseth's Harvard University project noted that they received fresh insight through the process of reflecting on ideas and experiences that they wanted to communicate in writing (1992, p. 680).

Overall, the research on computer networks for teachers indicates positive results. Merseth (1992) found that communication among teachers via computer networks provided benefits such as: readily available resources; an atmosphere of collegiality, support, and shared professional growth; improved reflection skills; and an awareness that problems are shared by

others. McMahon (1997) also listed several benefits of network-based professional development:

> (1) supporting group discussion, (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. (p. 14)

Research has also revealed some perceived disadvantages of networking. In a distance learning experiment which involved student teachers from a rural education program, some participants found it difficult to express and understand feelings and ideas in writing. The most commonly cited disadvantage was a lack of nonverbal feedback and the other supports that normally occur in face-to-face discussions. On a more technical level, the participants experienced trouble using the associated computers and technology (Clarken, 1993).

McMahon (1997) similarly identified technical drawbacks to telecommunication. She used questionnaires, exit interviews, and content analysis of on-line exchanges to monitor the attitudes of 35 teachers involved in three eight-week on-line courses. McMahon concluded that "network-based professional development is far from reaching its potential" (p. 13) and listed such technical obstacles as hardware and software problems, use of technology, and competition for connection time. She observed:

> 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 user's perspective. (1997, p. 1)

Thompson and Hamilton (1991) concluded that initially, teachers tended to use telecommunication for their own personal needs. A study of LabNet, a computer network designed for high school science teachers, supported this finding. A group researching the effectiveness of the network divided the professional discourse of LabNet participants into two categories:

> Network dialogues in the teaching activities category are those directly related to classroom work–for example, a conversation between two teachers whose classes are collaborating on a project. Teachers also spend much time "talking shop"–gathering information about science activities and teaching aids, improving technological expertise, and seeking additional financial and technological resources. (Ruopp, Pfister, Drayton, & Gal, 1993, p. 12)

In a later study of the LabNet experience, Muscella and DiMauro (1995) emphasized the importance of meaningful dialogue to promote professional development via telecommunication: "Its purposeful use seems well-suited in fostering meaningful learning for teachers" (p. 1). They went on to list ways in which telecommunication can offer new vehicles for professional development: "Support substantive and reflective conversations; have a particular focus (i.e. writing, science, school change, reflection on practice); create an environment that fosters colleagueship; and put teachers at the helm of their own professional development" (p. 3).

The results of studies of beginning teachers indicate that, although computer networking has been effective in providing moral support and reducing feelings of isolation, the ability of the network to offer support for teaching processes (e.g. management techniques, curriculum and lesson planning) has been less effective (Clarken, 1993, p. 11; Merseth, 1991, p. 145). Based on her findings with beginning teacher networks, Merseth speculated that this lack of formal teaching support may be due to the predominance of beginning teachers over experienced teachers using the network. She suggested that further research on linking beginning teachers with experienced teachers would be productive, and might reveal different supportive capacities for a network (1991, p. 146).

If telecommunication is to become an essential component of teacher mentoring programs, it is important to know how teachers use the medium, particularly specific populations such as science and mathematics teachers, rural teachers, and beginning teachers. Thompson and Hamilton called for "further research . . . to address the specific uses of the system and the contributions of these experiences to the effectiveness of the classroom teacher" (1991, p. 10).

In a review of key topics for future research on the role of computer networks in rural education, Gal (1993) referred to factors that influenced rural teachers in particular: isolation; resistance to change within the school; limited resources; lack of professional development; and the need for a

community of practice. He recommended research to investigate "the purposeful use of the network in the specific rural context. . . . What are the unique features of rural teaching, and how do telecommunication networks best apply to those features?" (1993, p. 42).

Montana's Mentoring Needs

In 1992, the Montana Certification Standards and Practices Advisory Council (CSPAC) began a three-year effort to research the effects of mentoring on new teachers' performance and attitudes. The project resulted in the publication of a manual to assist school districts and administrators in setting up mentoring programs for teachers within their districts. In the CSPAC model, veteran and beginning teachers in the same district were matched without regard for content area or grade level, and no mentor training was provided. This project represented Montana's only effort to implement a mentoring program at a statewide level prior to the initiation of the Early Career Support Program by the STEP Project. The designers and researchers of the CSPAC model, which is now inactive, showed the "overwhelmingly positive effect that mentoring can have in easing the transition from college to teaching, [and] in starting the development of a competent professional" (Zetler & Spuhler, 1997, p. 1). The STEP Project carried the mentoring model in Montana several steps further, with a strong conceptual framework, formal mentor training, and a structured implementation program.

Goals of the STEP Project

The Montana STEP Project, initiated in 1993, influenced the preparation of mathematics and science teachers from their undergraduate coursework through their first years of teaching. One of the three original Collaboratives for Excellence in Teacher Preparation (CETP) funded by the National Science Foundation (NSF), STEP served as a national model for statewide collaboration between institutions spanning the K-16 spectrum. The Montana collaborative included the state's university system, the tribal college system, and numerous K-12 schools and districts, with support from professional organizations, education leaders, and other grant-funded projects.

STEP's five-year effort to reform teacher preparation in mathematics and science followed a sequence similar to that followed by a new teacher preparing for and embarking on a career in education. The first strand, which was given priority during the first three years of the project, focused on undergraduate course reform, with an emphasis on revising content and methods courses in mathematics and science for K-12 preservice teachers. A second strand initiated in Year Two of the project addressed the student teaching field experience; the focus was on identifying and promoting a number of model school sites with exemplary mathematics and science programs and teachers. In Years Three and Four, K-12 model site educators

continued to develop their programs, working in partnership with university professors and placement officers to recruit student teachers to their sites.

The third strand of the STEP Project's teacher preparation agenda sought to provide mentoring and a supportive professional environment for beginning science, mathematics, and elementary teachers, particularly those in rural areas. The Early Career Support Program was designed and implemented to meet this goal. Its focus on beginning rural teachers prompted a creative blend of program components which combined formal training for mentors, modeling of science and mathematics content and practice, productive use of telecommunication, and a sensitivity to rural education issues. Three of STEP's guiding project goals were directly related to the Early Career Support Program:

- provide early career support for mathematics and science teachers in a rural setting during their first years of service;
- use Montana's extensive telecommunications network as a key component in the development of teacher preparation models for rural schools; and
- design, implement, evaluate and disseminate new ideas in preparing mathematics and science teachers at all levels.

The fourth and final strand of the STEP Project was threaded through the other three: Recruit and retain women and minorities, particularly Native Americans, in the mathematics and science teaching fields. This

effort was evidenced in part by the choice of Indian reservations for two of the model school sites and by the creation of a scholarship program which heavily supported Native American students pursuing education degrees. In 1997-98, at least ten percent of the mentors and novice teachers in the ECS Program taught in a Native American setting.

Definition of Terms

Research in the area of rural teaching and mentorship does not call for command of a technical vocabulary; however, several familiar terms do require clarification in the context of the STEP Project's Early Career Support Program and this study.

1. *Novice teacher:* a beginning teacher in the first five years of professional experience; also referred to in the research as an early career teacher or an inductee. The term "novice" will be used from this point forward.
2. *Mentor teacher:* an experienced teacher (five or more years of classroom experience) with demonstrated qualities of educational leadership and a strong background in mathematics and science instruction. The mentor's role is that of an advisor or sponsor who offers insight, guidance, and support to his or her protege (Odell, 1990, p. 6).
3. *Rural:* in relation to more populous areas of the United States, every Montana community could be considered rural. For the purposes of this

study, a rural school is defined to mean a school serving a rural district or a community with fewer than 2,500 inhabitants.

4. *Telecommunication:* in regard to mentoring, this term refers to personal exchanges between teachers using computer conferencing and electronic mail (or *e-mail*), usually via the Montana Educational Telecommunication Network (Metnet), which is accessed using FirstClass® Client software. In the classroom sense, a curriculum activity based on telecommunication can include data-sharing with other online classrooms, downloading material from the Internet, or maintaining an exchange of ideas with another person or group via electronic mail.

Summary

Previous research has identified clear areas of need for novice rural teachers. In addition, the results of numerous studies demonstrate the positive effects of induction measures, particularly mentoring programs, on novice teachers. Most mentoring programs employ either established master teachers who serve a district or county, or same-building partner teachers. In situations where no experienced colleague working at similar grade levels or in similar subject areas is located nearby, mentoring partnerships must be differently designed.

The use of telecommunication for professional exchange and teacher interaction is a growing area of research, and recent studies indicate that

participation in a computer networking system provides benefits to novice teachers. Feelings of professional, social, and geographic isolation can be reduced by teachers who actively participate in electronic communication with peers and/or mentors.

For teachers in remote areas, or for teachers with particular needs based on their teaching assignment or school setting, distance-mediated mentoring partnerships can be set up with little regard to location or time. The STEP Project's Early Career Support Program provided such an opportunity, and supplemented it with teaching materials, workshop experiences, and occasional face-to-face interaction between mentors and novice teachers. The study reported here represents an effort to determine whether or not such distance-mediated mentoring partnerships can be adequately supportive, and to compare their impact on beginning rural teachers' mathematics and science instruction and professional growth against the proven benefits of a traditional mentoring program.

CHAPTER 2

DESIGN AND METHODOLOGY

Introduction

The study was carried out during academic years 1996-97 and 1997-98, which represented Years Two and Three of the Early Career Support Program (ECS Program) sponsored by Montana's Systemic Teacher Excellence Preparation (STEP) Project. The research goal was to characterize the ECS Program mentoring model and investigate its effectiveness for beginning rural teachers.

The need to explore the program from the perspective of its teacher participants drove the choice of a qualitative research design, which is "concerned with understanding behavior from the subject's own frame of reference" (Bogdan & Biklen, 1992, p. 2). The researcher formulated a set of questions and subgoals to facilitate the research process, but remained flexible in directing the research in accordance with Patton's view:

> Qualitative inquiry designs cannot be completely specified in advance of fieldwork. While the design will specify an initial focus, plans for observations and interviews, and primary questions to be explored, the naturalistic and inductive nature of the inquiry makes it both impossible and inappropriate to specify operational variables, state

> testable hypotheses, and finalize either instrumentation or sampling schemes. A qualitative design unfolds as fieldwork unfolds. (1990, p. 61)

The five-month process of initial data collection included: extensive telephone and face-to-face interviews; field observation of classrooms, schools, and communities; analysis of electronic mail exchanges; surveys comprised of demographic and descriptive questions; and participation in ECS Program workshops and seminars. Follow-up research conducted one year later employed a final set of interviews and a second survey. The essential elements of the research design and methodology, including data collection procedures and analysis techniques, are discussed in this chapter.

The use of telecommunication by mentors and novices inspired the collection of some data via electronic mail. The researcher was able to receive copies of electronic messages exchanged between selected mentor-novice pairs. This provided the opportunity not only to monitor the overall use of the communication network by mentor-novice partners, but to gain an inside view of the information exchanged between mentor partners without intruding into the conversation.

Contributions to Theory and Practice

As outlined in the review of literature, mentoring programs have proven effective in improving the experiences of novice teachers. Research on mentoring has shown that mentors facilitate the development of the