Abstract
This study investigated the purposeful use of asynchronous telecommunications in a science education methods/curriculum course involving the use of a non-restrictive, public Web-based forum with preservice science teachers. The findings in this study revealed most participants had positive attitudes towards interacting with the Web-based forum. Furthermore, there were no significant differences between participants’ attitudes with respect to access to a networked computer. The interface of the Web-based forum contributed to the shaping of reflective thinking. This study depicts how a group of preservice teachers can interact in a non-restrictive, asynchronous Web-based forum and participate in a community of practice.

Introduction
Student teaching has consistently been identified as the most significant element in the teacher preparation process (Guyton & McIntyre, 1990). It provides great opportunity to apply theory to practice in a more intense and prolonged situation than any prior preparation activity. However, distances to travel, schedule changes, and other logistic problems often limit the amount of communication and mentoring that occurs between university supervisors and student teachers.

Student teachers are disconnected from other classrooms. Once in a classroom, students find that the room becomes a world unto itself. They seldom visit other grades, other schools, or other teachers. They seldom reflect on and discuss their experience with their cooperating teachers (Fienmen-Nemser & Buchmann, 1987). Confined to the isolated
placement and interacting only intermittently with university personnel, preservice teachers rely almost exclusively on cooperating teachers for guidance, information, and support.

Student teachers are isolated from their peers. Scattered in their placements, preservice teachers are cut off from those with whom they might share, compare, discuss their experiences, and find support. According to Goodlad (1998), frequent opportunities to share experiences with other persons in similar roles and opportunities to reflect upon how theory and research can inform practice are two fundamental conditions needed for effective collaboration.

Preservice and inservice teachers view student teaching as an essential component in teacher preparation, but some researchers question the effectiveness of traditional student teaching models. Some research on student teaching suggests that interns abandon what they have learned in teacher education courses in as little as 2 weeks (Richardson-Koehler, 1988). Rather than working to apply what they have learned, they adapt and replicate the practices of their cooperating teachers.

Traditional student teaching often occurs in disconnection (Schlagal, Trathen, & Blanton, 1996). Placed in a school, student teachers are isolated from university faculty and course work. Their connections with university supervisors are limited by the demands on supervisor’s time. Furthermore, student teacher clinical supervisors are often those who do not teach earlier methods courses. The realities and complexities of real classroom experiences often vary from those envisioned during methods courses. As a result, students often dismiss as irrelevant what they learned in teacher education courses (Richardson-Koehler, 1988).

**Background**

**Preservice Teacher Telecommunications Training**

In recent years, Internet connectivity in schools has advanced substantially as a result of increased attention from national policy making leaders and community leaders. The
President's Educational Technology Initiative (Gore, 1996) calls for classrooms to be connected to one another, classrooms to be connected to the outside world, and teachers to be ready to use and teach with technology. In just three years, the percentage of U.S. public schools with Internet access increased from 35 percent in Fall 1994 to 78 percent in Fall 1997 (Bare & Meek, 1998). More instructional classrooms are becoming connected to online telecommunications. Bare and Meek (1998) also reported that the percentage of schools with Internet access in five or more instructional rooms increased from 25 percent in 1996 to 43 percent in 1997. A 1997 report from the National Center of Education Statistics (Heavside, Riggins, & Farris, 1997) indicated that 87 percent of the schools that lacked Internet capabilities reported planning to obtain Internet access by the year 2000. If these schools are able to acquire access, 95 percent of all American schools will have Internet access in the year 2000.

As more schools adopt new telecommunication technologies as part of recent reform movements, teacher preparation programs must do the same or risk widening the disparity between university teacher education and the new realities of the school environment. Many of today’s preservice teachers are not adequately prepared to use telecommunications technology to support teacher-facilitated technology-based learning experiences in educational settings. Teachers and technology: Making the connection (U.S. Congress, 1995) confirmed this by making us aware that technology is not central to the teacher preparation experience in most colleges of education. If novice teachers are expected to be familiar with and innovative in using telecommunications technology, they deserve early and continuous exposure to it at all levels of the preservice curriculum.

Telecommunication networks are transforming higher education. Recent developments in computer telecommunications technology have emerged as a means for providing support to beginning teachers. University teacher educators can continue to provide preservice teacher education with electronic networks when students are at remote student teaching placements. A fundamental advantage of computer networking is the
flexibility it offers. Geographical and time constraints are overcome because messages can be sent at any time of the day and from any place. Electronic communication can provide a communication bridge that increases the frequency of interactions among student teachers and university personnel (Thomas, Clift, & Sugimoto, 1996). The fact that the network is available 24 hours a day is a strength only this technology can offer. In addition, combining the network with good on-site support greatly improves the quality of supervision in teacher training (Casey & Vogt, 1994).

**Community Networks**

Some researchers have described electronic networks being used within the context of an educational community. According to Lemke (1990), communities are systems whose types can evolve because the material base of their [cultural] practices can preserve information, accommodate variability, and transmit information to future communities. Spaces, social systems, and the sense of belonging together are components of a community. Electronic social interactions are mediated through text that appears on a monitor screen, rather than through face-to-face interaction. Davie and Wells (1991) described a sense of community as the feeling of a supportive group of individuals working together to make meaning, combat mutual isolation as distance learners, provide support for and challenge to one another, and learn to value the contributions to oneself and others. Ruopp, Gal, Drayton, & Pfister (1993) describe a community of teaching participants who employ similar work practices, develop a similar teaching approach, use similar tools in their instruction, and communicate with people who share their interests. Schrum & Berenfeld (1997) defined a community as a basic form of social organization composed of persons living in the same locality who share common interests, values, and social goals. When members of a community are united by a common purpose and engage in mutual activities, they become a community of practice. In order for a professional community to develop, teachers must feel a sense of belonging to a given group (Lemke, 1989).
According to Caggiano, Audet, & Abegg (1995), teacher participation in electronic community networks can provide a channel for receiving validation about their work, forums for ideas, opportunities to share thoughts with colleagues, and exposure to innovations in pedagogical practices and innovations. Teachers can collaborate with advisors and other experienced educators to learn about new teaching strategies. Three types of active network participation is possible in an electronic community network: Putting forward topics for discussion, posting messages in a discussion, and reading messages (Caggiano et al., 1995). DiMauro and Jacobs (1995) contended that the LabNet network provided teachers with intellectual stimulation and supported teachers’ professional development by providing a community base that was different from one’s local community. Although some claims have been made regarding the benefits of networks, there has not been much broad scale systemic analysis of educators’ use of networks to support these claims or warrant the allocation of resources to such endeavors (Anderson & Harris, 1997; Honey & Henriquez, 1993; Office of Technology Assessment, 1995).

**Electronic Communities of Preservice Teachers**

The establishment of an electronic community network of preservice teachers is perhaps the most meaningful prospect that online telecommunications has to offer to preservice teacher education programs. An electronic community network of preservice teachers is a virtual community of student teachers who share teaching experiences, problems, new ideas, and pedagogical resources. These networks have the potential to offer preservice science teachers a vehicle to engage in reflective discourse with university supervisors and faculty from their remote student teaching locations.

A community network provides new means and opportunities for preservice teachers to reflect collaboratively on their practice (Bos, Krajcik, & Patrick, 1995). These networks can contribute to teaching practices by providing a flexible means of communicating between preservice teachers and university instructors, and by creating an online area for
mutual reflection and idea sharing (Bull, Harris, Lloyd, & Short, 1989; Thomas et al., 1996). Also, the ability to access the network at any time from multiple locations may be particularly well-suited to student teachers, whose activities are no longer centralized on the university campus (Weir, 1992).

In an online discussion group, it is much less likely for any member or group of members to dominate discussion. Everyone can contribute to the extent they feel comfortable (Harasim, 1990). By engaging in electronic community networks, students gain an understanding of how technology can promote collaboration and sharing of ideas. This is one of the most promising areas of telecommunications for teachers in the battle against isolation (Johnson, 1997). Because of the openness of the electronic classroom, all students have an equal opportunity to contribute on an individual and group level. Designing for group work and collaborative learning at a distance is a way to empower students through the establishment of a community of learners (Davie & Wells, 1991). Students become empowered as individuals by contributing to the group effort.

An electronic community network of educators is distinguished by the social nature of the learning environment it offers. Like face-to-face interactions, the network supports interactive group communication. Historically, the social, emotional, and cognitive benefits of peer interaction and collaboration have been available only in face-to-face learning. These networks can serve as a vehicle for preservice teachers to engage in reflective practice. Reflective practice involves asking focused questions, sharing concerns and perceptions, seeking common meanings in teaching practice, or constructing ideas in collaboration with other teachers.

**Facets of Preservice Electronic Communities**

Electronic community networks of preservice teachers using restricted e-mail listservs and bulletin board systems (BBSs) can provide socioemotional support to a cohort group (Bull et al., 1989; Casey, 1997; Merseth, 1991; Schlagal et al., 1996; Thomas et al.,
Preservice teachers use networks to share and discuss common experiences. Interactions often include sharing student teaching experiences and discussion of student teaching issues. (Thompson & Hamilton, 1991). Electronic communities offer an environment to interact personally, socially, and professionally by sharing thoughts, seeking advice, and sharing experiences with successes and problems over geographical distances (Caggiano et al., 1995; Harasim et al., 1995). This sharing of experiences appears to reduce isolation barriers that preservice science teachers often encounter during their student teaching experiences. In addition, using computer networks facilitates communication between preservice teachers and university supervisors and instructors (Waugh and Rath, 1995). Finally, telecommunications technology provides a medium that enables students to collaborate with one another as part of the learning process and facilitates information exchange (Harasim, Hiltz, Teles & Turoff, 1995).

Barriers and obstacles exist to the successful implementation of electronic networks with preservice teacher instruction. Student teachers have reported problems accessing networks due to lack of phone lines and access to modems in their school placement (Thompson & Hamilton, 1991; White, 1997). Students often experience tremendous amount of anxiety and frustration using e-mail (Campbell and Zhao, 1996). Purpose, ease of access, and convenience for task completion are important factors in promoting e-mail use, although users may perceive writing rather than speaking a type of depersonalized learning (Thomas et al., 1996). Often, students find e-mail helpful in communicating with instructors outside of class, but many perceive this to be time consuming, and of little worth (Nonis, Bronack, & Haton, 1998). Furthermore, students perceive using computer networks as being inconvenient (Angeli, Supplee, Bonk, & Malikowski, 1998; Waugh and Rath, 1995). On bulletin board systems, students may send messages to wrong conference topic areas that create confusion for participants (Harasim et al., 1995).
Asynchronous Web-Based Communication

The World Wide Web (Web) is familiar to students and very accessible at various university locations, K-12 schools, and at home by students with computers. In school placements today, a student can usually find one computer networked to the Internet that contains a Web browser software such as Netscape or Internet Explorer. Recent developments on the Web have made available inexpensive, fast, and broad opportunities for preservice teachers to have access to university supervisors and mentors.

Web-based forums provide a means in which university supervisors and methods instructors can continue to support preservice education students as a cohort group during their student teaching internships. Web-based forums automatically file messages into topical discussions and update users on any new comments in a topic. We believe that this new computer technology presents a more appropriate environment for online discussion than e-mail listservs because it provides a more user-friendly interface to navigate within the online system and easier access to the system from remote locations. Web-based forum discussions can occur asynchronously, permitting users to read, browse, or add to multiple discussions at their convenience. One does not need access to networks or systems at a particular university or at a particular time to participate in a Web-based discussion.

Web-based forums preserve a permanent record of the dialogue. According to Davie and Wells (1991), this permanent record challenges all participants to be accountable for their work and say precisely what they mean. By encouraging responsibility for one’s words, the transcript encourages an awareness that words are extensions of one’s self. Because a permanent record of class discourse is generated, any member of the class can return to earlier contributions, to rethink a position or pull together a thread of conversation, linking an earlier thought to a current thought.
Rationale for This Study

Although new teacher communications networks continue to be established in Colleges of Education around the country, the published descriptions of these systems are general and often do not include specifics about the use and implementation of these systems. Further, the capabilities of electronic networks seem a natural solution to help address teacher isolation, although some systems designed for this purpose are not actively used while others failed due to lack of use (Thompson & Hamilton, 1991). Because telecommunications technology is viewed as relatively new, it is increasingly important to understand what preservice teachers’ self-beliefs are concerning their ability to use telecommunications and computers in an instructional setting. Based on Bandura’s (1977) self-efficacy theory, it would follow that those who judge themselves to be efficacious in using telecommunications will anticipate positive and challenging telecommunications experiences. Those who see themselves as inefficacious are likely to expect negative experiences with using telecommunications.

Currently, there are no studies in the literature concerning the purposeful use of telecommunications in a science education methods/curriculum course involving the use of a Web-based forum. Each of the previous studies involving preservice teachers using telecommunications for purposeful discourse in a preservice education program have been conducted within the context of a restricted network. There have been no published studies involving preservice education students using asynchronous communication during their student teaching internships in which a public Web-forum served as the online community network space.

Since the World Wide Web is now easily accessible to preservice teachers at home, at the university, and in their student teaching placements, it is important that research be conducted to evaluate the impact of the use of Web-based forums on undergraduate science education students’ attitudes dealing with the utility and use of electronic community networks, as well as their attitudes towards this new technology. As Web based learning
tools proliferate in higher education settings, there is a need for focused research on how such technology augments and redefines academic learning environments (Koschmann, Myers, Feltovitch, & Barrows, 1994).

**Research Questions**

The purpose of this study was to investigate the purposeful use of asynchronous telecommunications in a science education methods/curriculum course involving the use of a non-restrictive, public Web-based forum with preservice science teachers. The particular areas of inquiry addressed by this research were

- What effects does the purposeful use of asynchronous Web-based telecommunications in a science education methods/curriculum course have on student attitudes towards electronic communications and computers?
- Does access to computers and networks play a significant role with respect to student’s attitudes toward new information technologies -- multimedia, electronic mail, and the World Wide Web?
- What are the students’ attitudes toward using an asynchronous Web-based forum during their student teaching field internship?
- Will students claim that they feel less isolated in the field?
- What aspects of the Web-based forum do preservice science teachers feel foster their sense of an electronic community of educators?

**Methodology**

The participants in this study were composed of 32 prospective secondary school science teachers enrolled in the Professional Semester (Methods of Teaching Science,
Instructional Materials in Science, Seminar in Science Education, and Student Teaching) at North Carolina State University during Fall 1998. Twenty-one participants were female and 11 participants were male. The age of the students ranged from 21-26 years with a mean age of 22.3 years and a median age of 22. The students’ initial telecommunications expertise and comfort level ranged from those with little experience and comfort using e-mail and the World Wide Web to those who felt very comfortable and used telecommunications on a daily basis. Most students (n=23) reported that they were not confident using a Web-based forum. Only four students had some type of previous experience using a Bulletin Board System (BBS), online chat, Web-based forum, or other electronic conferencing system.

The participants had completed the majority of their academic requirements for a Bachelor of Science degree in Science Education with 10 students concentrating in biological sciences, 10 in physical science, and 12 in middle school science and math. Students were on campus daily for course instruction during the first five weeks of the semester. All high school science preservice teachers (n=20) attended the Instructional Materials in Science course for two hours per day during these five weeks. These students were divided into different Methods of Teaching Science courses based on their science concentration area. The 12 middle school preservice teachers were instructed in a separate Instructional Materials course and a separate methods course from the high school preservice teachers.

Students were on campus daily for course instruction during the first five weeks of the semester. For the following ten weeks, each student was assigned to a public school in a school district near the University for a student teacher internship.

Teachers Attitudes Toward Information Technology Questionnaire

The Teachers Attitudes Toward Information Technology Questionnaire (TAT) was administered to each participant during their first day on campus in the Fall 1998 semester,
and also during the last week of the semester after completion of the their student teaching internships. The purpose of administering the TAT was to address the participants’ attitudes and perceptions of computers and telecommunications in education prior to their student teaching placement and after completion of their student teaching internship.

The TAT was developed during 1995-97 at the University of North Texas. TAT gathers data on 10 separate indices. Eight of these ten subscales were constructed using semantic differential items taken from Zaichkowsky’s (1985) Modified Personal Involvement Inventory, a context free 16-item semantic differential scale that focuses on a person’s perceived relevance of an object based on inherent needs, values, and interests using statements such as "to me _____ is". Two well-validated subscales from the Teachers Attitudes Toward Computers Questionnaire (TAC) (Christensen and Knezek, 1997) were also included on the instrument for comparison purposes: Kay’s semantic perception of computers and D’Souza’s classroom learning via e-mail. TAT addresses the following areas: Electronic mail, the World-Wide Web, multimedia, and the use of information technology to improve teacher productivity. A section on Web-based forums was added to the TAT for a post-internship comparison measure.

According to Knezek & Christensen (1998), internal consistency reliabilities for the ten TAT subscales ranged from a low of .91 to a high of .98. Content validity for the TAT is believed to be quite high due to the way the instrument was constructed. Subscales were selected precisely because various scholars and practitioners in the field had identified these areas as important but not measured by previously existing questionnaires.

Likert type questions to measure the participants’ confidence levels with computers and telecommunications tools were also added to the TAT survey by the researchers.

SciTeach Forum Survey

The SciTeach Forum survey (Appendix A) was administered to each subject at the end of their student teaching semester. The survey consists of open-ended questions, Likert-
type attitudinal questions, and multiple choice type questions designed to identify the preservice science teachers’ perceptions and attitudes regarding their experience interacting with a Web-based forum during their student teaching internship.

Interviews

Nine interviews were conducted from a stratified random sample of preservice science teachers. Preservice teachers were stratified based on their methods course. Three subjects were interviewed from each of the 3 different methods courses. The interviews addressed the participant’s experience, attitude, and perceptions with using the Web-based forum during the 5 weeks of on-campus course work and during their student teaching internship. Three interviews were conducted during the second week of the participants’ student teaching internship and six interviews were conducted during the week following the end of the participants’ student teaching internships. Interviews were recorded using audio tape.

Web-Based Forum Design

In order to examine the potential benefits of preservice science teachers engaging in an electronic professional community for science teachers on the World Wide Web, a public Web-based forum called the SciTeach Forum (Figure 1) was constructed in July 1997. The SciTeach Forum was placed in the context of a large public science education Web site. The SciTeach Forum serves as an online support network for both inservice and preservice science educators.

The SciTeach Forum was designed to be a place where science teachers share ideas, reflections, and conversations on teaching and implementation of technology in the
classroom and other instructional pedagogy, while also providing support for each other as members of an electronic professional community. The SciTeach Forum was designed with NetForum software. NetForum is a Web based group communication and collaboration system provided by the University of Wisconsin Biomedical Computing Group. The program is written in Perl and works on any UNIX-based system with Perl 4.0.1.8 or later that supports CGI subdirectories. Forums are organized into discussion topics and messages. A simple, intuitive toolbar allows user access to NetForum features. Forums can be created and managed by "forum owners" with the administrative tools via the World Wide Web. Forum topics and messages can also be edited via the administrative tools. Forum owners can customize many of a forum's features and can add html codes into the headers and footers of each of the forum's web pages.

NetForum software was selected to create the SciTeach Forum because it is available at no monetary cost since our institution has a site license to use the software. Another reason to use the NetForum software for this project is ease of use. In addition, the software allows the users to initially structure the discussion topics on the forum in any order. The software also enables any user to add a new discussion topic to the forum. Within each topic area, a user can post a new message, reply to a message, or reply to a reply of a message. When users first enter a topic area, they are presented with a list of message and reply titles. Each message and reply title displays the author of the message and the date the message was posted on to the forum. The most recent message is listed at the top of the screen. Each message and reply title is a hypertext link. The user clicks on a message or reply title to view the posted message. The software also enables the user to read an entire thread of successive replies to the original message.

The SciTeach Forum can be accessed by anyone with a connection to the World Wide Web. A special e-mail account or password is not a requirement to read forum messages or post messages to the forum. Unlike most of the other previous studies involving preservice teachers using telecommunications during their student teaching semester, there
was no additional funding to equip the preservice science teachers with laptop computers and telephone modems. We assumed that at least one computer in the school where a student teacher would be placed during his/her student teaching internship would have online access to the World Wide Web.

The SciTeach Forum contains discussion topics relating to teaching science content, incorporating instructional technology into the curriculum, and topics relating to teaching pedagogy in general.

The preservice high school science teachers were introduced to the SciTeach Forum during the first on-campus day of their Instructional Materials in Science course during the Fall 1998 semester. The preservice middle school science and math teachers were introduced to the SciTeach Forum during the fourth on-campus day of their Methods in Science and Math course. Each student was instructed how to use the SciTeach Forum in class and required to post a message on the forum to introduce themselves in the “Preservice Science Teachers” discussion topic area. As part of the required course work, each student was required to post two messages each week to the SciTeach Forum for the entire semester. Of these two postings, one posting each week was required to be placed into the “Critical Incidents in the Science Classroom” topic. Critical incidents are defined as an event which confronts teachers and makes them decide on a course of action which involves some kind of explanation of the scientific enterprise (Nott & Wellington, 1995). The majority of the instructor-posted critical incidents placed on the forum adhered to this definition. A few of the critical incidents posted involved non-specific science pedagogy issues that could apply to any preservice teacher. These included issues such as covering all course objectives for the “end of the course test” and aspects of the student-teacher/cooperating teacher relationship.

Findings and Discussion

Attitudes Towards Electronic Communications and Computers
T-tests for dependent samples were conducted for each of the six TAT index means (pre student teaching vs. post student teaching) at an alpha level equal to .05 to test for a significant difference in student’s attitudes towards information technology and computer use. Significant differences were found for Kay’s semantic perception of computers and the Multimedia subscales. The post test results were significantly higher than the pre test measures for these two sub scales. The participants had a more positive attitude toward computers and multimedia after their student teaching internship. No significant differences were found on the other sub scales (see Table 1).

A two sample t-test assuming unequal variance was conducted to test for significant differences in attitude towards electronic communications and computers categorized by access differences based on TAT post-student teaching responses. Eleven students were placed in an “inadequate access” group based on their response to a survey question regarding their access to a networked computer. These students did not have access to the World Wide Web in their homes and had no access or had limited access to the Web in their school placement. No significant differences (p<.05) in student attitudes towards electronic communications and computers were found with respect to network access differences. Subjects with inadequate access to a networked computer did not have significantly lower TAT post-test score means than subjects with adequate network access on six subsections of the TAT (see Table 2).

The participants’ confidence levels in using computers and telecommunications tools significantly increased after the student teaching semester (see Table 3).
Bandura’s (1977), self-efficacy theory refers to perceptions about one’s capabilities to organize and implement actions necessary to attain a designated performance skill for specific tasks. Bandura (1977) defines an outcome expectancy as a person’s estimate that a given behavior will lead to certain outcomes. An efficacy expectation is the conviction that one can successfully execute the behavior to produce the outcome. Outcome and efficacy expectations are differentiated, because individuals can believe that a particular course of action will produce certain outcomes, but if they entertain serious doubts about whether they can perform the necessary activities such information does not influence their behavior. Even though some participants had difficulty accessing a networked computer, their repeated success in using telecommunication technologies to access the Web-based forum produced positive and challenging telecommunications experiences. As one student stated:

There were problems with the computer at school. It had Internet, it just wouldn’t connect. It would pop up this little thing that says having problems connecting to host. So, that was a problem in and of itself. It would take a real long time and never pop up. It would literally have days that it worked and days that it didn’t work. That’s why I would get so frustrated. It was not fun. But I found out from another student teacher that the one I would use all the time was the one that really had problems. All the rest of them were okay. I guess the phone line was funny on that one or something had to be wrong with it. I just assumed it was an Internet problem with all the computers, so I never tried another computer. Once I learned about this, I was okay. I was able to get on a different computer and do my postings.

Our findings are consistent with Bandura’s theory of self-efficacy being affected by temporal patterns of successes and failures. Vicarious experiences with the computer increase one’s feelings of control and confidence (Olivier & Shapiro, 1993). These encounters also make an individual want to learn more about the technology, thus reducing and eventually eliminating the fear of the unknown factor. As the fear and the anxiety
diminish and positive experiences add up, self-efficacy and the willingness to cope with mastering the task will increase.

**Attitudes Toward Using a Web-Based Forum**

Mean scores and standard deviations from the attitudinal Likert-type questions of the SciTeach survey responses are displayed in Table 4. An examination of these scores reveal that most participants had positive attitudes towards interacting with the Web-based forum. Furthermore, there were no significant differences between participants’ attitudes with respect to access to a networked computer (see Table 5). This result was surprising. Some studies have cited easy access to equipment so that networks can be used conveniently to be an important considerations for network use (Anderson & Harris, 1997; Honey & Henriquez, 1993). Honey and Henriquez (1993) reported that inadequate access to telecomputing facilities from school buildings was among the most frequently cited barriers to using networks in public schools. According to Schrum (1995), unless time is built into the school day, or educators have access to telecommunications equipment at home, telecommunications are most likely not going to be used by an educator. Furthermore, other studies have reported that preservice teachers perceived not owning a personal computer as a barrier to using an electronic network (White, 1997; Zimmerman & Greene, 1988).

Our findings tell a different story. We believe that these barriers were most likely overcome because the network was more accessible on a Web-based forum rather than on a e-mail listserv or dial-up BBS. Half of the participants did not have their own computers and modems at home and had to access the forum either at their school placement (n=8) or back
on the university campus (n=8). For many participants, accessing the Web-based forum was easier than accessing their campus e-mail.

“Not everyone has an off-campus e-mail account and getting to campus to check it is difficult during student teaching. Accessing the World Wide Web off-campus is much easier.”

During the semester, some students with telecommunications access at home found it difficult to access their university e-mail accounts from home. Many participants stated that the Web-based forum provided a better way to communicate with other students during their internships than an e-mail listserv.

Our survey and interviews revealed preferable attitudes among the participants to use a Web-based forum for this activity rather than an e-mail listserv. Many found the Web to be more accessible and user-friendly than e-mail for this type of activity. As one participant stated:

“E-mail is different because you don’t have topics to choose from to read about. You are forced to read the whole e-mail which may not be beneficial. I like how easy it was to post and reply messages on the forum. I think it was better than the way e-mail is set up. I think the Web-based forum is better because you had choice.”

Web-based forums present a more appropriate environment for online learning than e-mail listservs by providing more user control in the online environment. Furthermore, the Web-based forum provides a more user-friendly interface to navigate within the online system and easier access to the system from remote locations. Some of the participants accessed their e-mail from home with Telnet and stated that it was cumbersome to have to continually scroll through each line of text. Some participants also had difficulty with using Telnet to access their campus e-mail accounts. Many participants felt more user control to pick and choose topics of interest to them.

“E-mail lists are annoying. Web forum allows you to read only what you want and doesn’t fill up your e-mail box.”
Many participants felt reading the messages on the forum was preferable than being overwhelmed by a large number of e-mail messages in one’s e-mail box. The SciTeach Forum averaged 60 messages each week.

“If you’re on a listserv, I was on one for chemistry education, I’d get 25 messages a day. I didn’t read them. I’d read the subjects and if there was something I wanted to read, I would maybe read through it. But the rest of them I would go through and delete. Whereas with the Web-based forum, it’s not crowding up your e-mail box. You can pick and chose what you want to read. It’s similar because you look at the subject, and you say, well, I guess I’ll read that one. But you don’t have to worry about deleting the ones you don’t want to read. When you get 25 messages that you don’t care about in your e-mail box and you have to go through them to get to your important personal stuff, that’s kind of aggravating.”

It appears that participation in the Web-based forum has overcome many technical and logistical issues that shape network adoption and use. These include the user friendliness of the system, system reliability, and technological infrastructure. As reported in previous studies using e-mail listservs and BBSs (Bos et al., 1995; Coulter & Walters, 1997; Danin, S. 1993; Eurich-Fulcher and Schofield, 1995; Harasim et al., 1995; Rogan, 1995), our participants did not experience frustrations connecting to a local carrier, accessing the telecommunications network, or becoming lost in the online system.

The participants stated many beneficial aspects of using the SciTeach Forum during their student teaching internships. These benefits included being able to hear the opinions, ideas and suggestions of other student teachers, sharing peer experiences, discussing critical incidents in science teaching, obtaining support from peers, and experiencing reduced feelings of isolation during the student teaching internship. Participants stated that they received a variety of different types of learning assistance on the forum. These included
assistance with classroom management problems, activities, lesson planning, obtaining instructional resources, developing critical thinking skills to improve their teaching practice, and developing teaching portfolios.

On the Web-based forum, preservice teachers became engaged in thoughtful discourse about science teaching practices. The structure of the critical incidents themselves seems to be an important factor in the development of common meaning that appeared in the student discourse. The critical incidents were structured in such a way “that it gets you to think” by having to respond to a focused question raised about a complex issue that could occur during student teaching in a science classroom. They were authentic problems that the preservice teachers could “relate to”. The forum discourse was thoughtful and promoted a reflective practice in which this group of preservice teachers engaged in a dialogue that involved asking focused questions, seeking common meanings in teaching practice, and constructing ideas in collaboration with other preservice teachers.

Reducing Isolation in the Field

“I was the only student teacher at my school and I felt kind of alone. I could never talk to any other student teachers. The only ones around me were real teachers. It was nice whenever I got on there and it was like other people are feeling the same way that I am and having the same problems that I am. Things like that. I felt like I wanted to comment on every thing that everybody said.”

This statement comes from a participant who was the only student teacher intern placed at her school. She did not have the opportunity to have face-to-face interactions with her peers at her student teaching placement. The participants received and provided support for one another by sharing experiences and frustrations. As one participant stated:

“Some of the stories picked me up when I was down. It was also helpful to know that others out there were facing some of the same problems I was.”
The Web-based forum provided a convenient network space for the participants to have opportunities for conversations pertaining to moral support over geographical distances. This support tended to lend itself to a decreased feeling of isolation among the participants who were placed in schools without other interns. The sharing of peer experiences on the Web-based forum appears to reduce isolation barriers that preservice science teachers often encounter during their student teaching experiences. The forum provided a means for the preservice teachers to receive help and support for the problems and tensions they experienced during their student teaching internships. This finding is consistent with other research suggesting that telecommunications networks can provide support to beginning teachers (Bull et al., 1989; Casey, 1997; Merseth, 1991; Schlagal et al., 1996; Thomas et al., 1996). The open structure of the Web-based forum appears to be an important factor in the free exchange of ideas, questions, and other types of dialogue among preservice science teachers that helps reduce the feeling of loneliness.

An Electronic Collaborative Community of Educators

Most participants felt that the Web-based conferencing activity fostered a sense of a collaborative learning community (see Figure 2). Participant interviews revealed similar perspectives that fostered this sense of community. The Web-base forum allowed the participants to have an equal opportunity “to talk and speak their opinion”. One participant stated that the forum is like a community “because there are people who want to be a part of it and there are people who are not going to want to be a part of it.” Some participants felt that posting to the forum “like everything else during student teaching, demands another small chunk of your time each week.” Many participants stated that a lack of personal time was a problem they encountered when using the Web-based forum. We concur that much time is involved when one must sit, think, reflect critically, and then write a response to a message posting on a Web-based forum.
A sense of community was fostered because the group of forum participants experienced similar situations. “Being in the same boat, we were able to communicate a lot easier. You could find similarities in people.” Even in similar situations, members of this Web-based community did not have the same opinion. Participants “are not going to see a situation the same way”. Some participants stated that this community benefited by being non-restrictive, since it enabled people from all over the world to enter and contribute to this community.

The forum provided a common space where the participants felt comfortable sharing their experiences with people they had never encountered before in face-to-face interactions. As one participant stated:

“If you were on the street, you wouldn’t just walk up to someone and try to communicate with them or say something to them because you would be afraid of their response. Like how are they going to take me face-to-face. How are they going to respond with me walking up to them and being like hey, how are you? On the computer, when you type something, it creates community because you meet someone and its not so awkward. Its not like walking up to someone face-to-face. You’re finding a common link between you and you’re building on that.”

By interacting with others in the online network space, this participant didn’t feel threatened to engage in the discourse. This community had a sense of unity fostered by an awareness that they were each a science educator engaged in mutual activities. Much reflection occurred on science-specific pedagogy within this Web-based community. Our findings are consistent with previous research that online networks can provide emotional support, curriculum support, and a place to reflect on issues of teaching with peers in the same
situation (Angel et al., 1998; Bull et al., 1989; Casey, 1997; Merseth, 1991; Schlagal et al., 1996; Thomas et al., 1996).

Conclusions

In traditional student teaching internships, preservice teachers are often disconnected from their peers in other classrooms. Using a Web-based forum, preservice science teachers had the opportunity to question their peers’ assertions, open different aspects of a problem, or apply reflective thinking on an issue presented. Because the interface of the Web-based forum permits immediate feedback, it contributed very effectively to the shaping of reflective thinking. The forum provided opportunities for preservice teachers to engage in dialogue and reflections, providing ongoing opportunities for science concepts to be discussed and examined. The SciTeach forum provided a place for preservice teacher reflection and communication with one another across geographical distances. Interacting with a variety of different topics on the forum provided preservice science teachers the means and opportunity to develop as reflective practitioners. Preservice teachers became engaged in thoughtful discourse about science teaching practices, classroom management strategies, teacher-student interactions, and other issues pertaining to the nature of teaching. We believe that the ability to communicate asynchronously on a Web-based forum is well-suited to preservice teachers placed at remote student teaching placements.

The rules of communication change when one engages in participating in a Web-based forum. Non-facial communication issues are inherent to this situation. Communication exchange is not guaranteed among all participants since one can select which postings to read or not to read. Most participants (n=28) stated that they read messages posted on the forum by scanning the content for issues of interest while disregarding messages or skimming others. Furthermore, the comfort level with the Web-based medium itself might be a factor related to how students communicate with each other. In Web-based communication, there are no personal nuances such as facial expressions or
hand gestures which accompany the dialogue. Since the forum provides a means to communicate asynchronously, it permits the more timid and reflective learners in a group a chance to participate in the discussion more than they might in a face-to-face conversation. The structure of the forum also enables each participant the opportunity to have time to reflect on what has been said, think critically, and then respond. As one participant stated:

“In Web-based communication, you say what you need to say. If you mess it up, you can go back and delete it. You can be right to the point.”

The findings in this study illustrate how a group of preservice teachers can interact in a non-restrictive, asynchronous Web-based forum and participate in a community of practice. Preservice teachers experienced a sense of belonging together. This online community space provided the feeling of a supportive group of individuals working together to seek common meaning in teaching, support for one another, and an opportunity to learn how to value the contributions of others. As an online community of practice, preservice teachers become united by a common purpose as they are engaged in mutual activities such as lesson planning, classroom management experiences, reflecting on teaching experiences, and developing into a professional educator. As a community, preservice teachers share teaching experiences, problems, ideas and pedagogical resources. The Web-based medium itself promotes a reflective practice as a place where preservice teachers share ideas, perceptions, and seek common meanings in their teaching practices.

Given our results, we plan to continue to use public, non-restrictive Web-based forums with our preservice science teachers. We want our preservice teachers to not only develop expertise in their field, but to become reflective practitioners as part of their ongoing professional development. As a result of this research, we are continuing to understand how preservice science teachers can communicate with their peers and instructors from remote
locations using the World Wide Web to develop into a reflective community network of practice.

References


Table 1. TAT Pre and Post Survey Results

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<tr>
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Note. For E-mail D’Souza sub scale, highest possible score = 6, lowest possible score= 1. For all other sub scales, highest possible score = 7, lowest possible score= 1. High score represents more positive attitude.
*p< 0.05

Table 2. TAT Post Survey results for access differences

<table>
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<th>t-stat</th>
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Note. Adequate access (AA): n=20
Inadequate access (IA): n=11
Table 3. Telecommunications tools confidence levels before and after the student teaching semester

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Note. Highest possible score = 6 (very confident), lowest possible score= 1 (not confident). Highest score represents most positive attitude.
* p< 0.05
Table 4. Mean Scores for the Attitudinal Likert-Type Questions  
Likert Scale: 1 = Strongly Disagree, 6 = Strongly Agree

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<thead>
<tr>
<th>Statement</th>
<th>Mean</th>
<th>SD</th>
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<tbody>
<tr>
<td>I was able to get help with lessons and curriculum planning using the SciTeach Forum. (Q22)</td>
<td>3.03</td>
<td>1.49</td>
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<tr>
<td>Because I can talk to others on the forum, I felt more personally connected to NCSU when in the field (i.e., less lonely and isolated). (Q24)</td>
<td>3.78</td>
<td>1.74</td>
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<td>This Web-based conferencing activity fostered my generation of ideas and creativity. (Q25)</td>
<td>3.84</td>
<td>1.25</td>
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<td>This Web-based conferencing activity fostered my evaluation of ideas and critical thinking. (Q26)</td>
<td>3.97</td>
<td>1.25</td>
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<td>I was able to keep in touch with classmates using the SciTeach Forum. (Q20)</td>
<td>4.09</td>
<td>1.57</td>
</tr>
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<td>The SciTeach Forum has helped me to develop a broader perspective on teaching. (Q19)</td>
<td>4.10</td>
<td>1.40</td>
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<td>Interacting with the SciTeach Forum has promoted my reflection on teaching approaches and decision making. (Q13)</td>
<td>4.20</td>
<td>1.00</td>
</tr>
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<td>The SciTeach Forum is an asset to the science teacher education program at NCSU. (Q15)</td>
<td>4.30</td>
<td>1.30</td>
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<tr>
<td>Interacting with the SciTeach Forum has promoted reflection on what I learned during my student teaching semester. (Q12)</td>
<td>4.41</td>
<td>1.01</td>
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<td>The SciTeach Forum helped me improve classroom management. (Q21)</td>
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<td>1.34</td>
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<td>I provided support for others through the use of this forum. (Q23)</td>
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<td>This Web-based conferencing activity fostered a sense of a collaborative learning community. (Q27)</td>
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I feel that I received support through my interactions with the SciTeach Forum. Examples include sharing classroom experiences and discussing student teaching issues. (Q17)
Mean = 4.75       SD = 0.92

I feel that the SciTeach Forum facilitated communication with other student teachers. (Q14)
Mean = 4.80       SD = 1.30

The SciTeach Forum helped me exchange teaching ideas, information, or advice. (Q18)
Mean = 4.84       SD = 1.17
Table 5. SciTeach Forum Survey attitudinal response results for access differences

<table>
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<th>Item</th>
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Note. Adequate access (AA): n=20
Inadequate access (IA): n=11
Figure 1. The SciTeach Forum.
Fostered a sense of a collaborative learning community

Mean=4.7
SD=1.1

Figure 2. Participant response to survey question: This Web-based conferencing activity fostered a sense of a collaborative learning community.
Likert Scale: 1= Strongly Disagree, 6 = Strongly Agree
Appendix A. SciTeach Forum Survey

Once this survey data is tabulated, your name will not be used.

Open response questions:

1. What was the most beneficial aspect of using the SciTeach Forum during your student teaching experience?

2. What is the least beneficial aspect of using the SciTeach Forum during your student teaching experience?

3. What types of learning assistance and support did you receive on the forum?

4. Did your peers give you much feedback? If so, what was it and how did it help? If not, what could be done to improve it?

5. What types of topics or discussion threads spurred the most discussion?

6. List any instructional techniques or activities that you learned from the SciTeach Forum.

7. Were you able to communicate with other student teachers with “face-to-face” interactions at your school placement?

8. Have you ever discussed forum topics with anyone else? If so, with whom? Which topics did you discuss?

9. How can such a Web-based conferencing tool contribute to the professional development of preservice and licensed teachers? Feel free to suggest any idea that comes to mind, even if you think it may sound too expensive or very silly.

10. How is communication on the Web-based forum different from face-to-face communication?

11. How does the Web-based forum promote or inhibit online discussion?

12. How would communicating with an e-mail list be different from using a Web-based forum? Which do you think would provide a better means of communication during your student teaching internship? Why?
13. How do you think the discussion on the SciTeach Forum would be different if access was restricted only to NCSU preservice teachers and faculty?

14. What improvements would you suggest for the SciTeach Forum?
SciTeach Forum Survey (part 2)

Once this survey data is tabulated, your name will not be used.

1. Did your school have access to the World Wide Web?  
   yes  no
   If yes, where in your school could you access the SciTeach Forum?

2. Were you able to access the SciTeach Forum from your home?  
   yes  no

3. From where did you access the SciTeach Forum? (list all)
   ________________________________________________________________

4. How often did you access the SciTeach Forum?
   daily  2-3 times/week  once/week  twice/month  once/month

5. How often was it possible for you to access the SciTeach Forum?
   daily  2-3 times/week  once/week  twice/month  once/month

6. How did you read the messages on the SciTeach Forum?  Check all that apply.
   ___ checked to see who sent messages
   ___ scanned the content for issues of interest disregarding messages or skimming others
   ___ checked to see when the latest messages were posted in a topic area
   ___ always went to the “Critical Incidents” area first
   ___ always went to the “Preservice Science Teachers” area first
   ___ other; Please describe:

7. How often did you go back to a topic area to check for responses to your message postings?
   ___ always
   ___ sometimes
   ___ rarely
   ___ not at all
8. Which barriers or problems did you encounter when using the SciTeach Forum? Check all that apply. Leave it blank if an item was not a problem.

___ Inadequate access to a networked computer.
___ Lack of personal time.
___ Insufficient time for learning how to use the forum.
___ No source of ongoing assistance to use the SciTeach Forum.
___ Slow response of the web site.
___ Other, Please list:
Please respond to the following statements by marking an “X” on one of the blanks below.

9. Adequate training was provided to use the SciTeach Forum in your student teaching placement.
   strongly disagree- __ __ __ __ __ __ -strongly agree

10. Getting to a computer to access the SciTeach Forum was....
    very difficult- __ __ __ __ __ __ -very easy

11. Finding the forum on the World Wide Web was....
    very difficult- __ __ __ __ __ __ -very easy

12. Interacting with the SciTeach Forum has promoted reflection on what I learned during my student teaching semester.
    strongly disagree- __ __ __ __ __ __ -strongly agree

13. Interacting with the SciTeach Forum has promoted my reflection on teaching approaches and decision making.
    strongly disagree- __ __ __ __ __ __ -strongly agree

14. I feel that the SciTeach Forum facilitated communication with other student teachers.
    strongly disagree- __ __ __ __ __ __ -strongly agree

15. The SciTeach Forum is not an asset to the science teacher education program at NCSU.
    strongly disagree- __ __ __ __ __ __ -strongly agree

16. The SciTeach Forum is a resource I might use during my first year of teaching.
    strongly disagree- __ __ __ __ __ __ -strongly agree

17. I feel that I received support through my interactions with the SciTeach Forum.
    Examples include sharing classroom experiences and discussing student teaching issues.
    strongly disagree- __ __ __ __ __ __ -strongly agree

18. The SciTeach Forum did not help me exchange teaching ideas, information, or advice.
    strongly disagree- __ __ __ __ __ __ -strongly agree

19. The SciTeach Forum has helped me to develop a broader perspective on teaching.
20. I was able to keep in touch with classmates using the SciTeach Forum.
   strongly disagree- ___ ___ ___ ___ ___ ___ -strongly agree

21. The SciTeach Forum did not help me improve classroom management.
   strongly disagree- ___ ___ ___ ___ ___ ___ -strongly agree

22. I was able to get help with lessons and curriculum planning using the SciTeach Forum.
   strongly disagree- ___ ___ ___ ___ ___ ___ -strongly agree

23. I provided support for others through the use of this forum.
   strongly disagree- ___ ___ ___ ___ ___ ___ -strongly agree

24. Because I can talk to others on the forum, I felt more personally connected to NCSU when in the field (i.e., less lonely and isolated).
   strongly disagree- ___ ___ ___ ___ ___ ___ -strongly agree

25. This Web-based conferencing activity fostered my generation of ideas and creativity.
   strongly disagree- ___ ___ ___ ___ ___ ___ -strongly agree

26. This Web-based conferencing activity fostered my evaluation of ideas and critical thinking.
   strongly disagree- ___ ___ ___ ___ ___ ___ -strongly agree

27. This Web-based conferencing activity fostered a sense of a collaborative learning community.
   strongly disagree- ___ ___ ___ ___ ___ ___ -strongly agree